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CHRISTMAS.

This season, whose very name has a sort of opulent suggestiveness to most persons, is looked upon in many different ways by different electrical people—with satisfaction by the seller of lamps, with dreadful anticipations of a possible breakdown in the midst of the heaviest loads of the year by the central station man, with delightful complacency by the makers of electric toys. To most it means the beginning of the holiday time which forms the little period of rest between the close of one year's work and the beginning of the next. This year the electrical fraternity has well deserved its Christmas holiday, because of its brave front through a past season of hard times, and its quick recovery from their effects. To all the members of it, collectively and individually, THE ELECTRICAL WORLD wishes a Merry Christmas and a prosperous New Year.

RAPID TRANSIT IN NEW YORK.

The tribulations of the underground rapid transit project in New York have been of a varied and interesting kind. A new chapter has just been added by the opinion rendered December 17 in the Appellate Division of the Supreme Court, regarding the recent recommendations of the Rapid Transit Commission. This opinion approves the undertaking, but it saddles it with what some think an almost impossible condition. It also leaves unsettled the question of the ability of the city to undertake the work without exceeding its limit of indebtedness. The probable immediate outcome is a reference of the whole matter to another court to settle the legal questions raised in this opinion, which means that several million people must wait for decent service a while longer.

A brief history of the case may be of interest here. The present scheme of a rapid transit road, running underground from the Post Office to the suburban districts north of the Harlem River, is by no means a new idea. Several years ago a Board of Rapid Transit Commissioners developed detailed plans for the work. A franchise was offered at public auction, but there were no bidders. In consequence, the city by popular vote agreed to undertake the construction on its own account. The original project was then rejected on the score of expense. A new plan on a more modest scale was worked out by the Commissioners, the estimated reduction in cost being $20,000,000. This soon found itself in court, as a result of opposition on the part of inimical interests, and in the summer of 1896 a committee of three citizens was appointed by the Appellate Division of the Supreme Court to thoroughly investigate the whole matter. This committee's report was entirely favorable, and it is on this report that the opinion of the Appellate Division bears.

During all the time that these various legal steps have consumed popular sentiment in favor of the construction of the road has grown. The crying necessity for an adequate system of transit has become more and more evident, and the constricted growth of the city, hampered by the wretchedly insufficient service of the elevated and surface lines, is perfectly apparent to anybody. The effect of the grudging consent to the construction of the road given by the Court, despite the amazing provision requiring an indemnity bond of $15,000,000 from the contractor, will probably be the letting of the contract to a syndicate formed for the purpose, followed immediately by another suit to determine the legality of the contract in view of the statutory limit of indebtedness, which the city must not exceed.

The decision of the justices is not clear as to the duration of the enormous bond required, and the uncertainty as to whether it is intended to hold only during the time of construction or during the entire period of operation interferes seriously with the action of intending bidders.

There is widespread and general dissatisfaction with the means of transit now in existence in this city. The steam operated elevated roads are crowded to their utmost limit and entirely inadequate. The new electric conduit surface roads will help, but the necessarily slow speed imposed upon them by their situation in the streets really makes them a small factor in the kind of transit demanded. To quote the opinion of the Court, "the imperious necessity of improved means of transit in the City of New York has long been recognized." Despite the obstructive action of the Court it is now possible that the "imperious necessity" may be satisfied, although this decision has not, as suffering residents of upper New York hoped it would, cleared up the last of the legal preliminary work.

THE RESPONSIBILITY OF THE GOVERNOR.

Engines for electric generator driving are almost universally made with but one speed regulator or governor. The proper action of this device is depended upon to prevent the admission of a greater power than that consumed and the consequent running away of the engine. The only alternative control is the manual operation of the throttle valves by the attendants, which in times of emergency is decidedly uncertain. In such a plant, for example, as that of the Astoria Hotel, described in this issue, there are four exceptionally large cast iron fly wheels built up in sections and held together only by links shrunk into place across the points of discontinuity in the rims. There is but one governor on each engine, the simple sticking or binding of which might at any time cause a runaway. To be sure, a special butterfly valve is arranged with an automatic trigger, but that is operated from the same governor, so that in the event of the sticking of the governor that valve would be inoperative. A special contact device is also rigged to throw open the circuit breaker, but that is apparently more of an element of danger than of safety, as it would relieve the load of the machine and allow it to accelerate the faster. The dynamos are compound wound and work with a storage battery, a combination involving many chances of motoring. The tremendous damage which would result from the explosion of one such fly-wheel under such a structure, crowded as it always is with occupants, would make the application of an independent speed limiting device to serve as a check upon the governor a wise investment. While the cutting of a slot through the Hotel Astoria is not, of course, very probable, with the existing arrangement, the serious nature of such an accident would appear to render advisable the adoption of every precaution and the reduction of the probability to the smallest practicable limit.

A QUESTION OF LIGHT.

The candle-power as a measure of lighting effects is a highly unsatisfactory unit, owing to the fact that it is not based upon the apparent effect on the human eye. Any true standard of illumination is a very hard thing to settle upon, as the estimation of relative intensities of illumination is highly erratic and largely dependent upon a personal element. No one ever considers, for example, that a 32-cp light illuminates a given space with twice the brilliancy of a 16-cp light. In the article on "Life and Candle-Power of Incandescent Lamps," to be found in another column, the important effect of diffusion is considered. The use of high candle-power lamps is discouraged, as two 16-cp lamps may be made to give a much more uniform and much better diffused illumination than one 32 candle-power, diffusion in this connection being considered as that quality which gives absence of shadows. This being the case, it is probably true that still better effects might be obtained with smaller candle-powers, 8-cp lamps being preferable in this respect to those of 16 candle-power, owing to the possibility of a wider distribution with twice the number of sources of light. In European countries, and especially in England, the 8-cp incandescent lamp is the standard size, but in this country the 16 candle-power has become the standard, owing largely to the difficulty found in making a high efficiency lamp with the high resistance necessary for 8 candle-power at 100 volts or more.

The harmful effect of intense sources of illumination is best shown by the open arc lights. They have become notorious for the difficulty they cause in seeing anything beyond them, owing undoubtedly to the effort of the eye to adjust itself to the intense illumination, thereby unfitting itself for the observations of comparatively dark surroundings. This effect is partially remedied by the enclosed arc, in which the illumination is emitted from a globe much larger than the arc itself, and in the case of open arcs with large translucent globes the effect is still further reduced. In case the efficiency of light transmission is no lower in the case of the large globe than the smaller globe of the same material and thickness, there would probably be a great gain effected by enlarging the size of the diffusing globe in all arc lights.

RECEIVERS FOR HERTZ WAVE SIGNALS.

In the discussion of the problem of wireless telegraphy so far, the coherer has enjoyed the distinction of being the only instrument regarded as capable of receiving Hertz wave signals, especially when these are somewhat attenuated by reason of long travel or a comparatively weak source of origin. While admitting the delicacy of the coherer it may be at the same time worth while to examine into the merits of the remarkable wave detector or galvanometer described in the article by Messrs. Northrup, Pierce and Reichman which is concluded in this issue.

This simple instrument consists of a ring of silver suspended obliquely across the axis of a small coil which is connected with some form of resonant circuit upon which the waves impinge. In sensitiveness it seems to be equal to the coherer, while it has considerably greater range of adjustment and apparently greater applicability to practical work. Used somewhat after the manner of the Thomson reflecting galvanometer, in the early days of cable work, it might furnish a reliable and satisfactory instrument for the reception of wave signals. At least it merits further experiment and research.

THE WORK OF THE WIZARD.

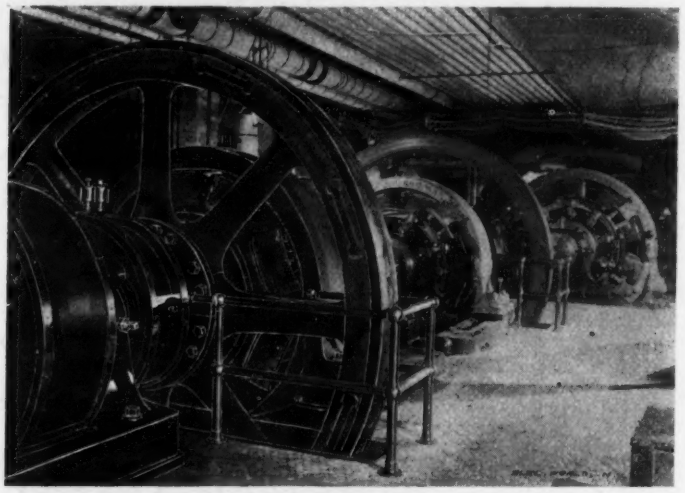
In the year of grace which is just drawing to a close there have been many silly things printed, but probably the silliest was a performance of one of the New York newspapers which recently published an illustrated description of an apparatus for photographing thoughts, together with a picture of the alleged inventor, the latest wizard to make his appearance. The mysterious details of the instrument were not fully set forth, but the picture of the inventor was large and complete. It appears that he is a young man, but that he has inherited talents in advance of his years.

How long the daily newspapers are going to flatter the vanity of irresponsible and half-baked "inventors," or pander to the schemes of charlatans and delude readers who are not versed in technical matters by this kind of thing, is hard to say. While such articles hurt no one who understands such matters, they may work injury to those who do not. They also tend in a measure to throw discredit upon the work of genuine investigators and experimentalists, and bring the whole art of invention into evil repute. The one consolation about it all is that such folly must recoil first and hardest upon the journal that perpetrates it.

The Electric Plant of the Astoria Hotel.

THE Waldorf Hotel has become famous the world over as one of the largest and most magnificent of caravansaries. This hotel was built some years ago by members of the Astor family, and its financial success has now induced another branch of the family to build adjacent to it a still larger and more magnificent structure called the Astoria. The two buildings have been leased by the same manager, and are to all intents and purposes one hotel, by far the largest and most magnificent in the world. It stands on New York's most famous and fashionable street, Fifth avenue, between Thirty-third and Thirty-fourth Streets, fronting 200 feet on the avenue and 350 feet on either street, and rising sixteen floors to a height of 250 feet above the basement. To complete the open space around all sides of the structure, the buildings to the rear have been removed and a courtyard left to give light and air on the fourth side, the farther side of the courtyard being occupied by a new building known as Astor Court.

The Waldorf Hotel was originally equipped with the best known type of isolated electric plant at the time of its construction, namely, the three-wire system supplied by twin generators direct-coupled to the two ends of centre crank high-speed horizontal engines. The elevators were of the hydraulic type, and all auxiliary apparatus was steam driven. This plant will now be shut down and only held as a reserve, the new plant in the Astoria part of the structure carrying the whole load of both hotels and Astor Court. This is probably

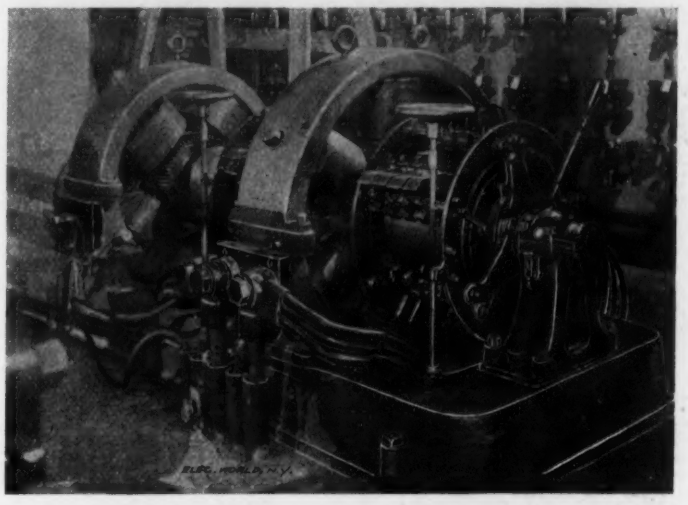


THREE OF THE MAIN UNITS.

the greatest load on any isolated plant in existence, the number of lamps being over 25,000, besides twenty-one electric elevators and a vast amount of auxiliary electrically driven apparatus.

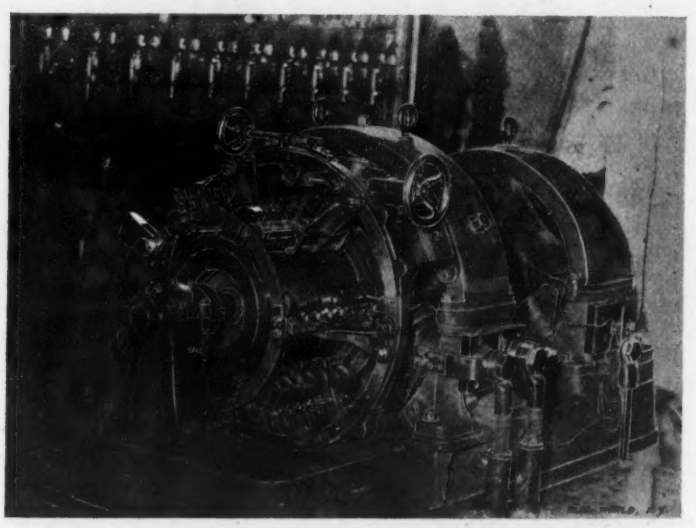
The power plant occupies almost the entire sub-basement of the building, the floor of which is 32 feet below the street level, the basement above the plant being utilized for the enormous kitchens of the hotel. The boiler plant consists of a battery of seven Babcock & Wilcox water-tube boilers, aggregating 2000 horse-power. They deliver steam at 125 pounds pressure to a duplicate system of steam piping, which supplies the various engines, the pipes being covered with cork enclosed in a canvas wrapping. No expansion joints are used, the flexibility of the elbows of the system being depended upon to take up the changes in length. Drain pipes are tapped off from the steam pipes at every low point and led to a common tank. The steam is passed through separators before entering any engine.

There are in all seven engines for generator driving. Six of these are of the Allis-Corliss make, and drive the main generators of the system; the seventh is a smaller Ames high-speed engine driving a 40-kw booster. The six large engines are of the single cylinder horizontal type, four of them of 400 horse-power each, with cylinders 25 inches in diameter by 42 inches stroke, running at a normal speed of 90 revolutions per minute. The smaller engines are of the same design but of only 160-hp capacity each, their cylinders being 16 inches diameter by 42-inch stroke, and their speed 100 revolutions per minute. Exceptionally heavy segmental cast iron fly wheels, 15 feet in diameter, are mounted on each unit. Each of the engines is provided with a safety device to shut down the engine in case the governor belt gives way. It consists of an idler heavily weighted and resting on the governor belt, the arrangement being such that if the latter breaks the weight falls and forces the governor balls upward to their highest position. In the main steam pipe just above the hand valve there is a butterfly valve arranged to close by the



DOUBLE COMMUTATOR BOOSTER.

force of a heavy weight which is held by a trigger. Should the governor balls rise for any reason beyond a certain predetermined limit, this weight is tripped and the steam instantly cut off. There is also an electrical device with contacts on the governor which will open the circuit breaker if the engine speed rises or falls beyond certain limits. This is effected by a small auxiliary coil on the trigger plunger of the circuit breaker energized by current from the bus-bars and connected through contacts on the governor which are closed only when the speed is abnormally high or low. This device is intended to open the circuit breaker if an attempt is made to throw in the dynamo before proper speed has been attained, without depending upon the rush of current in the main circuit, and to act in various other emergencies; although the complications involved in the

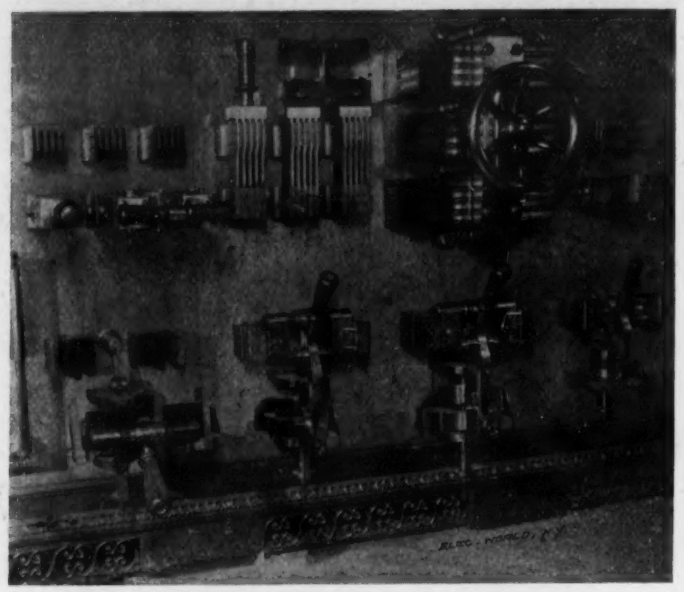


SINGLE COMMUTATOR BOOSTER.

combination of magnetizing effect with that of the main series coil of the circuit breaker, especially in case of the motoring of the generators must be carefully guarded aganst.

The main dynamos are of the multipolar type, and were made by the Walker Company, of Cleveland, Ohio. They are direct-coupled to the engines. The four large machines are ten-pole 250-kw generators, and the two smaller ones are eight-pole 100-kw machines. The machines contain all of the latest Walker features. For convenience

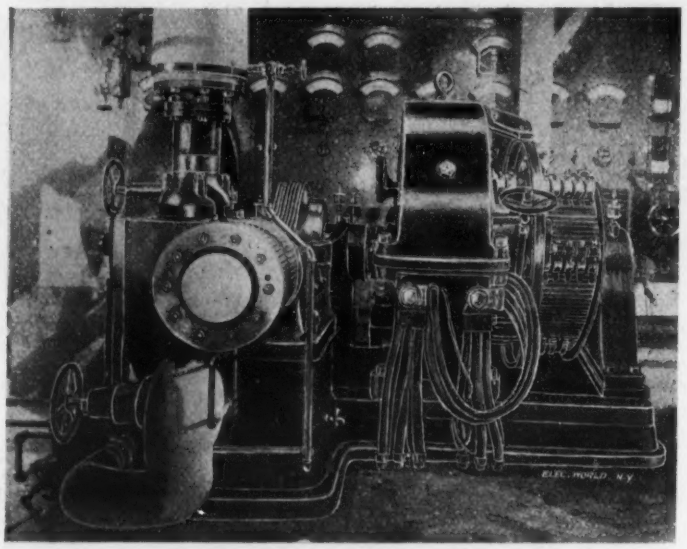
in inspecting and repairing them the field magnets can be moved in a direction parallel with the shaft until the armature is fully exposed, thus enabling the ready removal of either field or armature coils. This motion is effected by two long screws at the end of the foundation frame. The length of the shaft which appears in the illustrations is to make room for the frame so that it can completely clear all obstructions when moving as described. The generators are compounded for a three-volt rise in potential at full load and operate at



Bus-Bar Switch and Dynamo Switches and Circuit Breakers.

120 volts. The ampere capacity of the two sizes of machines is respectively 2083 and 833. These dynamos are provided with a device arranged to simultaneously lift all the brushes, which is something new with the peculiar Walker brush holders.

The dynamos operate in multiple, with an equalizer connection, delivering their output to three large bus-bars at the back of the switchboard. The positive and equalizer terminals are connected to the bus bars through a double pole switch, while the negative lead to the bus bars passes first through a single pole switch and then the machine circuit breaker. In starting up a machine the double switch is closed first. This puts the series coil in multiple with the series coils of the machines in operation, gives the initial excitation,

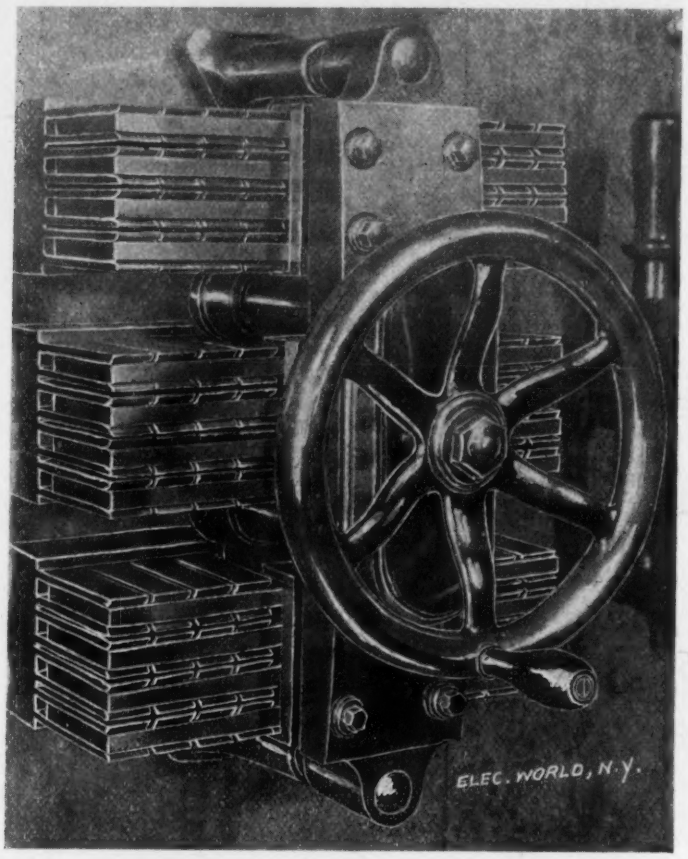


Engine-Driven Booster.

insuring the building up of the shunt field in the right direction. When the proper voltage has been reached the machine is thrown in by closing the single pole negative switch. A group of machine switches can be seen in one of the illustrations.

On the negative lead of each generator there is an overload alarm arangement, which can be set for any value. When the current exceeds a certain amount a red lamp on the switchboard becomes lighted and a bell rings.

The switchboard itself is a very elaborate affair, manufactured by the General Incandescent Arc Light Company, of New York. It is divided into three sections; the main panel, which occupies the centre and comprises about two-fifths of the board; the lighting panel to the left, which carries the lighting feeders, and the power panel on the right, which distributes current to the elevators and motors. The three bus bars, which are 10 square inches in section, are each divided into four lengths, which can be coupled together by heavy three-pole switches. These switches are of special construction, and one of them is depicted herewith. As will be seen it consists of three massive systems of copper straps, which are thrust in between appropriate jaws or withdrawn at will by means of a hand wheel and screw. These switches are not intended to break any current, but simply to connect and disconnect the sections of the bus bars together when they are of equal potential. Three such switches unite the four sections of the bus bar. The main switchboard panel has four Thomson integrating wattmeters. Two of these wattmeters measure the power supplied to the lighting circuits of the Astoria and Waldorf respectively. The third and fourth measure the energy in the power feeders. Some of the more important circuits are provided with re-



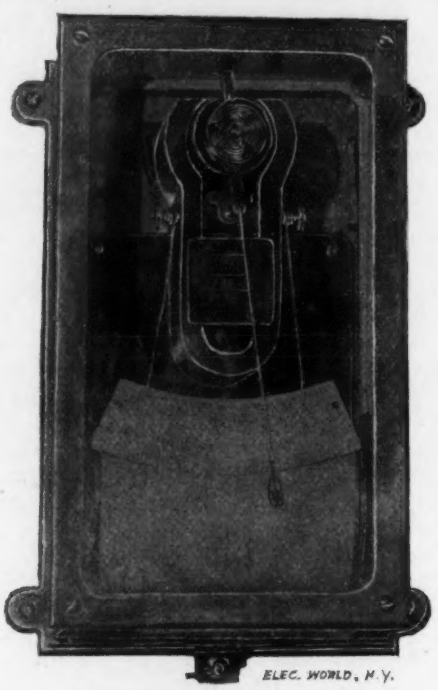
Three-Pole Bus-Bar Switch.

cording ammeters and voltmeters. One of these instruments is illustrated. It consists of a d'Arsonval coil, mounted in the field of a permanent magnet and carrying on its index an ink roller, which traces a record on a revolving drum propelled by clockwork. The main switchboard has a full complement of illuminated dial ammeters and voltmeters, and these are elaborately gilded to match the trimmings of the panels. The circuits on the main switchboard consist of six generator circuits, one storage battery circuit, and one supply circuit for the Waldorf Hotel.

The pressure of the current supplied to the Waldorf Hotel feeders is raised by a special motor driven booster. This machine, which was made by the Western Electric Company, is of 15-kw capacity, its maximum E. M. F. being 5 volts, and its carrying capacity 3000 amperes. To provide for the efficient generation of such a large current at such a low voltage, the machine is provided with a commutator at each end of the armature. The two commutators might have been connected to the same winding, and, in fact, it was originally proposed to make the machine in this way, but in order to provide for possible desire to boost two separate circuits, two windings respectively connected to the two commutators were put on the armature. The machine is six-polar, and is direct coupled to a six-pole motor, the booster field being excited by a

high resistance winding connected across the bus bars and controlled by a hand rheostat. The load being purely a lighting load the hand regulation is sufficient, as the variations are neither numerous nor sudden. The commutator segments of these machines are of massive construction, but a few of them being necessary for the low voltage, and the highest possible conductivity being necessary on account of the great amount of current to be carried. The brushes are of a special construction designed by the Western Electric Company for low voltages and high conductivity, and consist of alternate copper and zinc leaves. A lever on either side enables all of the brushes to be simultaneously raised. By means of this machine the pressure across the Waldorf Hotel feeders can be boosted 5 volts in addition to the 3 volts overcompounding of the main dynamos, the latter being sufficient for the shorter feeders of the Astoria Hotel proper.

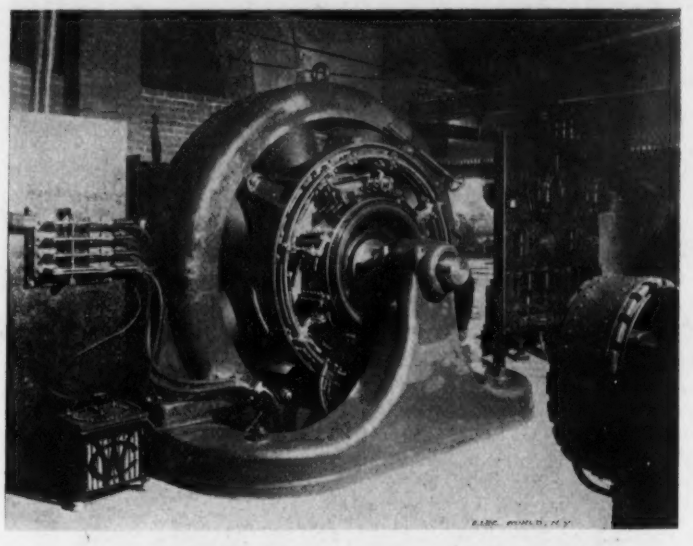
On the switchboard each lighting feeder is provided with a double pole switch and a single pole circuit breaker, the load on the principal feeders being measured by illuminated dial instruments, which are symmetrically arranged above the switches and circuit breakers. The bus bars of the power system are supplied with current from two sources in multiple with each other, the first being any one or more of the main generators which may or may not be



RECORDING AMPEREMETER.

simultaneously delivering current to the lighting system, and the second being a battery of chloride accumulators.

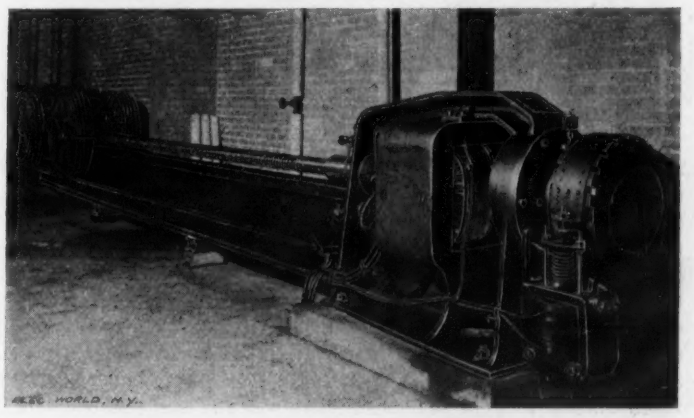
To render the pressure of the lighting constant and independent of the fluctuations caused by the demand of the power system a special booster arrangement is used. Two boosters are provided, both being differentially wound. One is a 40-kw machine, built by the Western Electric Company, and direct-coupled to the Ames engine mentioned above. This machine is capable of generating 25 volts and carrying 1600 amperes. The other machine is motor driven, and resembles closely in appearance the motor driven booster used for the Waldorf feeders, the essential difference being that it is a single commutator machine, the double commutators being unnecessary on account of the higher voltage and lower carrying capacity. Its capacity is one-half that of the engine driven machine, namely, 800 amperes at 25 volts. Either or both of these machines may be connected in series with the storage battery, the series fields—which are provided with an adjustable shunt to vary the compounding according to the number of generators in use—in this case carrying the currents supplied to the power system. The tendency of the E. M. F. set up by the shunt fields in this case is to oppose that of the storage battery and help charge the latter. As the series excitation strengthens and overcomes that of the shunt fields, the E. M. F. of the booster armature dies out until, in case of a heavy load on the elevator and power system, the series field more than overcomes the shunt field and builds up a voltage helping the storage battery to discharge and help out the main generators. The arrangement is such that the machines can also be connected between the generator bus bars and the bus bars of the power circuits. In this case the storage battery is connected straight across the power circuit bus bars and the boosters are so arranged that their series fields pull down their voltage as the load rises, thus throwing the variations on the accummulators. This has the same effect, so far as the lighting system is concerned, as the fluctuations of the motor system are thrown entirely on the storage



SLOW SPEED VENTILATING MOTOR.

battery, the load taken by the storage battery and power system together being a constant, thus preventing any fluctuations of the voltage of the main generators. But the effect on the motor system is obviously quite different in the latter case described than in the former, as in the latter, the voltage on the motors is not only allowed to fall as the load rises, but is helped to fall, in order to throw the whole fluctuation on the storage battery. In the other case, namely, that in which the booster is connected in the storage battery circuit, the storage battery is over-compounded by an amount sufficiently greater than the over-compounding of the main generators to cause the storage battery to take up the fluctuations. In the one case, the voltage across the motor terminals falls as the load rises, and in the other it rises.

The storage battery consists of 60 cells of chloride accumulator all in series with each other, and rated at 4500 amperes hours on a



SCREW ELEVATOR MACHINE.

discharge rate of 450 amperes, the capacity being, as with all storage batteries, less as the discharge rate is increased, coming down to only 2000 ampere hours at a 2000 ampere discharge rate. This is, however, considered an excessive rate, although 1000 amperes can be readily carried for short periods of time. The cells are made up in ash tanks, lead lined, 50 x 20 inches in size, and 24 inches deep. There are 49 plates in each cell. The battery is accommodated in a special room about 30 feet square, which gives sufficient space for all the cells on the floor level. The room is provided with a special ventilating fan. When the hotel was first opened, work being still carried on behind the switchboard, a workman laid his monkey wrench across the main bus bars. The circuit breakers of all the generators flew out, but an attendant reached the board in

time to hold in the circuit breakers of the storage battery and the smaller motor driven booster, namely, that rated at 800 amperes. The current rose to a value considerably over 2000 amperes, all from the storage battery, of course, and remained at about that figure for several minutes, until normal running could be resumed. The battery and booster stood this accidental test perfectly, there being no sign at the time or afterward of overloading on either.

The motor system of the whole installation is unusually extensive. There are seven large motors in this plant for ventilator driving alone, all of the Crocker-Wheeler make, and ranging in capacity from 24 to 90 horse-power. The larger motor is shown in one of the illustrations. It drives three large ventilating fans, and can be run at three speeds, as may be desired. Its operation is so smooth and sparkless that it is difficult to tell whether the machine is or is not in operation.

The details of construction of this motor are of particular interest. The motor has eight poles, the cores of the field magnets being cast steel, round in shape and cast solid in the circular cast iron yoke. This yoke has an internal flange on each side, which partly covers the field coils, affording them considerable protection from mechanical injury and at the same time allowing good ventilation. The poles are supplied with removable cast iron shoes, clamped in place by screws after the field coils have been slipped into position. These

Elevator Panels.

shoes reduce the density of the magnetic flux in the air gap and permit thereby a long air gap, which is of great value mechanically. The armature is of large diameter and short length. It is cable wound, the conductors being threaded through insulating tubes, which are shoved into the slots. These tubes consist of layers of pressboard, micanite and oiled muslin rolled up and glued together. The conductors on issuing from the slot bend downward and pass under a ring near the shaft, passing upward once more and entering a slot about 45 degrees from the first slot. The conductors are heavily taped outside the slot and are held in place at the ends by clamps. A casting at the coupling end protects the winding, so that the armature before mounting on the shaft can be stood up on this end without injury. The armature is thoroughly ironclad, and can be rolled along the floor without damage. The coils are fastened in the commutator tails by means of solder, and these tails are left sufficiently long to keep cool and hold the solder, even if the commutator should by accident become overheated. The armature winding is thoroughly impervious to moisture and dust, and permits such ample ventilation that severe overloads can be withstood without destruction of the insulation, although they may raise its temperature above normal. The armature core is mounted on a cast iron spider, which has an extended sleeve upon which the commutator is mounted. The commutator is of large diameter and ample face. The method of supporting the brush rods does away with the clumsy cable connections between brushes of the same polarity. Two carrying rings are used, which while mechanically supporting the brush rods connect them electrically, the rods being fastened to them. One of these rings holds all the positive and the other all the negative studs. The rings are insulated from each other, but are mechanically one, and shifting of the brushes is obtained by moving them just as a purely mechanical holder would be moved. The rings, therefore, do away with the insulating of the brush rods and the connecting of alternate studs by cables. On account of the room saved by this arrangement, the carrying rings are placed next the armature, permitting the studs to point outward and over the commutator, which leaves the commutator much more easy of access and greatly enhances the pleasing appearance of the machine. The brushes are carbon, held in pivoted radial holders, and are of ample size to carry the current at low density per square inch of contact with the commutator. The machine develops 90 horse-power at 140 revolutions per minute, and is designed to run at three speeds, namely, 100, 120 and 140 r. p. m. This regulation is obtained by varying the field strength by means of a field regulator. The motor is plain shunt wound.

The electric elevator system of the Astoria Hotel proper consists of nineteen Sprague elevators, besides two similar machines in the Astor Court building. Of the nineteen, nine are of the latest model of the screw type machines; seven of these being for passengers and two for freight and employees. Four others are simply sidewalk lifts, and the remainngi six are dumbwaiters for serving the various floors from the kitchen, etc.

The high speed screw machines run at a rate of 500 feet per minute, the sheave multiplication being 8 to 1. They are provided with some new features, chief among which is a safety device acting much as does an air cushion. The air cushion proper does not give the most desirable retardation, as the pressure is slight at first, and great when the car approaches the bottom of the shaft. The retardation in these new elevators is effected by buffers clamped to four heavy guides below the lowest floor to which the elevator runs. There are three sets placed about 3 feet apart, the total possible downward travel after striking the first buffer being 14 feet. These buffers are clamped up to give a retardation which while not severe enough to injure passengers, in case the elevator drops onto them, is sufficient to stop the car before reaching the bottom of the shaft. They are, of course, only a last resort, and are only called into use in case the main cables and the car safeties simultaneously fail. The cars are also provided with an automatic slowing attachment, which operates on approaching either end of the run. Ordinary push-button annunciators and revolving indicators are used. The passenger cars have a floor space of about 50 square feet, and are rated to carry a 3000 pound load. Like all other Sprague screw machines, they take power only on the up trip, being under counterweighted and coming down by gravity.

The screw machines used for freight purposes have a capacity of 4000 pounds, and run at a speed of about 400 feet per minute. The sidewalks lifts are of still greater capacity, namely, 5000 to 8000 pounds, their speed, however, being only about 50 feet per minute. Of the six dumbwaiters, four run from the basement to the roof of the hotel, the other two only as far as the second story. They have a carrying capacity of about 200 pounds, and run at a speed of about 400 feet per minute. They are of the Sprague Company's make "Type 4," and are controlled by hand wheels. A very complete system of doors and indicators is provided. The opening of any door turns the current off, so that the waiter cannot be moved. A complete system of call bells is provided, and indicators are placed on each floor.

An interesting new detail of the screw machines has been adopted in this hotel. The thrust of the screw has heretofore been passed from a revolving disc or plate to a stationary disc or plate by balls held from dropping out by a third plate running freely between the other two, and pierced with cylindrical holes, in which the balls are retained. The holes were arranged in spirals, by which the points of contact of the balls were as uniformly distributed as possible over the two thrust plates, but considerable wear took place nevertheless. In the new arrangement the intermediate free plate is pierced with square holes, in which small hardened steel cylinders are placed in such a way as to roll freely on the two plates, the area of contact being thereby rendered theoretically a line instead of a point. All the elevators were tried previous to the opening of the hotel, and every independent safety device was separately tested.

The engine and dynamo room of the hotel is eventually to be elaborately finished and decorated, and made one of the points of interest for visitors to this really remarkable structure.

Some Experiments on Induction with Currents of High Frequency at Long Distance—II.

BY EDWIN F. NORTHRUP, GEO. W, PIERCE AND FRITZ REICHMAN.

With a new inducing circuit, 22.5 m. by 9.4 m., and the receiving circuit, 14 m. by 8.4 m., results were obtained which are plotted in Diagram IV.

With the inducing circuit 22.5 by 9.4 and the receiving circuit 26 by 8.4 metres, the results were obtained which are plotted in Diagram V.

THEORY OF INDUCTION BETWEEN CIRCULAR CIRCUITS IN RESONANCE.

We shall now briefly examine the exact relation between the current in the inducing circuit and the current induced in the receiving circuit.

Call the inducing circuit S_1 and the receiving circuit S_2. S_1 consists of a circular loop of wire, with a condenser and spark gap in series. S_2 consists likewise of a circular loop, having a small coil (the coil of the instrument) and a condenser in series.

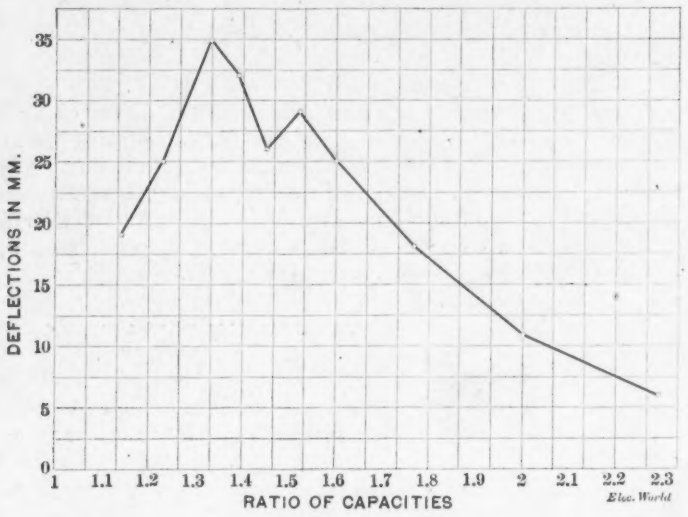


FIG. 4.

L_1, C_1 and R_1 are respectively the coefficient of self-induction, the capacity and the resistance of S_1. L_2 is the coefficient of total self-induction of S_2, being the sum of the coefficients of self-induction of the loop and of the small coil. C_2 is the capacity, and R_2 the total ohmic resistance of the circuit S_2.

Let M be the coefficient of mutual induction between the loops. Since the current in S_1 is an oscillatory current, and since the oscillations persist for some time, we may, without great error, treat the inducing circuit as if it had a harmonic E. M. F. impressed upon it of period T_1, the natural period of the circuit, and then proceed to inquire what current is set up by induction in the receiving circuit S_2. If e_2 is the E. M. F. impresed upon the circuit, and Φ is the electromagnetic flux through the single loop of this circuit, then

$$e_2 = \frac{d\Phi}{dt}.$$

But $\Phi = -i_1 M$ and $i_1 = I_1 \sin \frac{2\pi}{T_1} t$; therefore

$$e_2 = -M I_1 \frac{2\pi}{T_1} \cos \frac{2\pi}{T_1} t \quad \ldots\ldots\ldots\ldots\ldots\ldots (1$$

The general differential equation for the current i_2 in a circuit containing resistance, self-induction and capacity is

$$\frac{d^2 i_2}{dt^2} + \frac{R_2}{L_2}\frac{di_2}{dt} + \frac{i_2}{L_2 C_2} = \frac{1}{L_2}\frac{de_2}{dt} \quad \ldots\ldots\ldots\ldots (2)$$

From equation (1) we obtain

$$\frac{de_2}{dt} = M I_1 \left(\frac{2\pi}{T_1}\right)^2 \sin \frac{2\pi}{T_1} t.$$

In equation (1) let $\cos \frac{2\pi}{T_1} t = 1$, then the maximum E. M. F. impressed upon the circuit S_2 is

$$E_2 = -M I_1 \frac{2\pi}{T_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Whence, calling $\frac{2\pi}{T_1} = \omega_1$, equation (2) becomes

$$\frac{d^2 i_2}{dt^2} + \frac{R_2}{L_2}\frac{di_2}{dt} + \frac{i_2}{L_2 C_2} = -\frac{I}{L_2} E_2 \omega_1 \sin \omega_1 t \quad \ldots\ldots (4)$$

The solution of this equation is

$$i_2 = \frac{E_2}{\sqrt{R_2^2 + \left(\frac{1}{C_2 \omega_1} - L_2 \omega_1\right)^2}} \cos \left\{ \omega_1 t + \tan^{-1}\left(\frac{1}{C_2 R_2 \omega_1} - \frac{L_2 \omega_1}{R_2} \right) \right\} \quad \ldots\ldots\ldots (5)$$

+ exponential terms which vanish after a very short time has elapsed.

Hence the maximum current in the circuit S_2 is

$$I_2 = \frac{E_2}{\sqrt{R^2_2 + \left(\frac{1}{C_2 \omega_1} - L_2 \omega_1\right)^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Now let L_2 and C_2 vary in equation (6); then, since $\left(\frac{1}{C_2 \omega_1} - L_2 \omega_1\right)^2$ cannot be negative, I_2 has its greatest value when $\frac{1}{C_2 \omega_1} - L_2 \omega_1 = 0$ or, $\omega_1 = \frac{1}{L_2 C_2} = 2\pi N_1$, where N_1 is the frequency of the current in the inducing circuit. But the natural frequency of the circuit S_2 is $N_2 = \frac{1}{2\pi \sqrt{L_2 C_2}}$. Hence the induced current is a maximum when $N_2 = N_1$; that is, when the circuits are in resonance.

The equation for the current then becomes by (6) and (5)

$$I_2 = \frac{E_2}{R_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$i_2 = \frac{E_2}{R_2} \cos \omega_1 t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Equation (8) shows that at resonance the current induced in the receiving circuit is impeded only by ohmic resistance.

This fact may be made clear by the consideration of a mechanical analogue. Suppose a periodic force to act upon a mass attached to a stiff spring, the mass moving in a frictional fluid which offers resistance proportional to the velocity of the mass. If the impressed

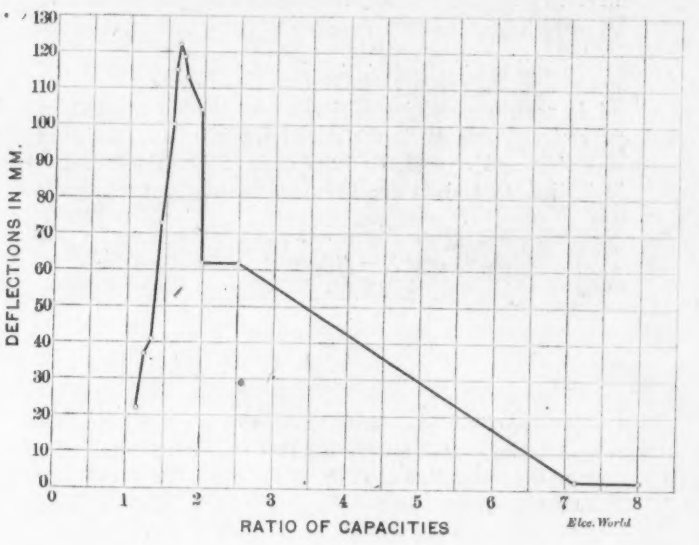


FIG 5.

force is not synchronous with the period of the spring it is opposed by the inertia of the mass, by the stiffness of the spring, and by the resistance of the fluid. If, on the other hand, the force has the same period as the mechanical system, after a short time the force and the elastic reactance of the spring come to act in the same phase, and the force has only to overcome the resistance of the fluid. Now the mass corresponds to self-induction, the stiffness of the spring to the reciprocal of capacity, and the frictional resistance to electrical resistance.

Recurring to equation (7), I_2 may be expressed in terms of the constants of the circuit. Substituting R_2, I_2 for E_2 in equation (3)

$$I_2 = \frac{-M \omega_1 I_1}{R_2} = -\frac{2\pi N_1 M I_1}{R_2} \quad \ldots\ldots\ldots\ldots (8a)$$

By Section 699, Vol II., Maxwell's "Electricity and Magnetism," when $\Theta = 0$ that is, when the planes of the circular circuits are

parallel, the potential energy between the two circuits when unit current flows in each circuit is expressed by the following series:

$$M = 1.2.\pi^2 \frac{A^2}{C^2} a^2 + 2.3.\pi^2 \frac{A^2 B}{C^5} a^2 b + 3.4.\pi^2 \frac{A^2(B^2 - \frac{1}{4} A^2)}{C^7} a^2 (b^2 - \frac{1}{4} a^2) + \text{etc.}$$

In which a = radius of smaller circle,
b = distance of its plane from the origin,
A = radius of larger circle,
B = distance of its plane from the origin,
$C = \sqrt{A^2 + B_2}$.

M is equivalent to the coefficient of mutual induction between the circuits. (Cf. Maxwell, Vol. II., Section 585.)

Assume the origin at the centre of the circle of radius a, and assume the distance between the circles great, then the terms after the first become small and may be neglected, and we may consider

$$M = 2 \frac{\pi^2 A^2 a^2}{C^3}$$

Let S_1 and S_2 be the areas of the circles respectively then

$$M = 2 \frac{S_1 S_2}{C^3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8b)$$

Substituting this value of M in equation (8 a) we obtain

$$i_2 = \frac{4 \pi S_1 S_2 N_1 I_1}{R_2 C^3} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

That is, for resonance circuits the maximum current induced in the receiving circuit, and hence passing through the coil of the instrument, is proportional to the maximum current in the inducing circuit, to the frequency, to the product of the areas of the circuits, and inversely proportional to the resistance of the receiving circuit, and inversely proportional to the cube of the distance between the circuits.

THEORY OF THE INSTRUMENT.

In the discussion of the instrument let us, to simplify the reasoning, assume that the coil of the instrument consists of n turns of fine wire, so packed together that the coil is a mere ring, and that the movable system is a ring consisting of a single turn of fine wire.

The coil and the ring, then, form two circular circuits, I. and II.

First, the force acting between I. and II., considering I. to have only one turn of wire, tending to change any geometrical variable z is:

$$Z = \frac{1}{2} i_2 \frac{d L_2}{d z} + i_2 i_3 \frac{d M_1}{d z} + \frac{1}{2} i_3 \frac{d L_3}{d z}$$

L_2 and L_3 are the coefficients of self-induction of the coil and the ring, respectively, and M_1 is the coefficient of mutual induction between the ring and one turn of the coil. Since the circuits move as rigid bodies, L_2 and L_3 are independent of the variations of z. Hence

$$Z = i_2 i_3 \frac{d M_1}{d z}$$

(See Maxwell "Elec. & Mag." Vol. 2, § 583.)

For the n turns of the coil the force is

$$Z_1 = n i_2 i_3 \frac{d M_1}{d z}$$

Take II. concentric with I., and free to rotate about a vertical axis. Let II. make an angle φ with I., and let the radius a of II. be smaller than the radius A of I. Then if we take the geometrical variable z normal to the plane of I.,

$$z = a \sin \varphi, \text{ and } d z = a \cos \varphi \, d \varphi$$

Therefore the deflecting force.

$$X = \frac{n i_2 i_3}{a \cos \varphi} \frac{d M_1}{d \varphi}$$

Resolving X in the direction of motion

$$X_1 = X \cos \varphi$$

The moment of this force is

$$X_m = X_1 a = a X \cos \varphi = n i_2 i_3 \frac{d M_1}{d \varphi} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9b)$$

Differentiating M_1 with respect to Φ, it may be shown that for very small variations of Φ (not exceeding 2 degrees) $\frac{d M_1}{d \Phi}$ is practically constant. Hence the moment of the force tending to change is

$$X_m = g n i_2 i_3 \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

in which g is a constant for small deflections.

It is next required to obtain values for i_2 and i_3 in terms of the constants of the circuits and the variable t.

The value of i_2 is given in equation 8.

i_3 is obtained as follows:

Let ε_3 be the E. M. F. impressed upon the movable ring, and φ_3 the electro-magnetic flux through the ring. Then

$$\varepsilon_3 = \frac{d \varphi_3}{dt}, \text{ but } \varphi_3 = - i_2 M_1 = - M_1 \frac{E_2}{R_2} \cos \omega_1 t \text{ (see Eq. 8).}$$

$$\text{Hence } \varepsilon_3 = M_1 \frac{E_2}{R_2} \omega_1 \sin \omega_1 t.$$

Let $\sin \omega_1 t = 1$, then

$$E_3 = M_1 \frac{E_2}{R_2} \omega_1 \text{ and}$$

$$\varepsilon_3 = E_3 \sin \omega_1 t.$$

$$\frac{d \varepsilon_3}{dt} = E_3 \omega_1 \cos \omega_1 t.$$

The general equation which has to be solved is then:

$$\frac{d^2 i_3}{d t} + \frac{R_3}{L_3} \frac{d i_3}{d t} = \frac{1}{L_3} E_3 \omega_1 \cos \omega_1 t.$$

The solution gives

$$i_3 = \frac{E_3}{(R^2_3 + L_3^2 \omega_1^2)^{\frac{1}{2}}} \sin \left(\omega_1 t - \tan^{-1} \frac{L_3 \omega_1}{R_3} \right) \quad \ldots (11)$$

[See Bedell and Crehore *A. C's Eq.* (28)]

Here L_3 is the coefficient of self-induction, and R_3 the ohmic resistance of the ring. E_3 is the maximum E. M. F. impressed upon the ring when it makes a definite angle with the coil. If the ring changes its angle considerably, that is, if the deflections are large, E_3 cannot be taken as constant, for E_3 involves M_1, which is different for different positions of the ring. It can, however, for very small deflections, be considered constant without great error.

Writing $\tan^{-1} \frac{L_3 \omega_1}{R_3} = \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$

$R_3 \tan \alpha = L_3 \omega_1$, and $L^2_3 \omega_1^2 = R_3^2 \tan^2 \alpha$. Substituting this value of $L_3^2 \omega^2_1$ in (11), $i_3 = \frac{E_3}{\{ R_3^2 (1 + \tan^2 \alpha) \}^{\frac{1}{2}}} \sin (w_1 t - \alpha)$

$1 + \tan^2 \alpha = \frac{\cos^2 \alpha + \sin^2 \alpha}{\cos^2 \alpha} = \frac{1}{\cos^2 \alpha}$, whence $i_3 = \frac{E_3}{R_3} \cos \alpha \sin (\omega_1 t - \alpha) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$

Substitute in (10) this value of i_3 and also the value of i_2 from (8), and we obtain:

$$X_m = \frac{g n E_2 E_3}{R_2 R_3} \cos \alpha \cos \omega_1 t \sin (\omega_1 t - \alpha) \quad \ldots\ldots (14)$$

But $\sin (\omega_1 t - \alpha) = \sin \omega_1 t \cos \alpha - \cos \omega_1 t \sin \alpha$, whence,

$$X_m = \frac{g n E_2 E_3}{R_2 R_3} \left(\sin \omega_1 t \cos \omega_1 t \cos^2 \alpha - \cos^2 \omega_1 t \cos \alpha \sin \alpha \right) \quad (15)$$

Write $G = \frac{g n E_2 E_3}{R_2 R_3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$

(15) is the moment of the force tending to rotate the ring at any instant of time, t. The average force which acts throughout one complete period of the oscillating current in circuit II., the period of which is T_1, is given by the expression:

$$\frac{1}{T_1} \int_o^{T_1} X_m \, dt = \frac{G \cos^2 \alpha}{T_1} \int_o^{T_1} \sin \omega_1 t \cos \omega_1 t \, dt - \frac{G \cos \alpha \sin \alpha}{T_1} \int_o^{T_1} \cos^2 \omega_1 t \, dt \quad \ldots\ldots\ldots\ldots (17)$$

The first integral on the right of the equation is o, the second is $\frac{T_1}{2}$.

$$\text{Hence } \frac{1}{T_1} \int_o^{T_1} X_m \, dt = - G \frac{\cos \alpha \sin \alpha}{2} \quad \ldots\ldots\ldots\ldots (18)$$

Calling this mean force y, and substituting in (18) the value of G in (16) we have:

$$y = - \frac{g n E_2 E_3}{2 R_2 R_3} \sin \alpha \cos \alpha \quad \ldots\ldots\ldots (19)$$

By (7) and (8a) $\frac{E_2}{R_2} = I_2 = - 2 \pi \frac{M I_1 N_1}{R_2}$ and

$$E_3 = - M_1 I_2 N_1 = 2 \pi \frac{M_1 M I_1 N_1^2}{R_2}$$

Substituting these values for $\frac{E_2}{R_2}$ and E_3 in (19) and letting H stand

for the constant terms of which no account is to be taken, we have

$$H = \frac{4\pi^2 g M_1}{2}, \alpha = \tan^{-1}\frac{L_2 2\pi N_1}{R_2}, \text{ and}$$

$$Y = H\frac{n M^2 I_1^2 N_1^3}{R_2^2 R_2}\cos\left(\tan^{-1}\frac{L_2 2\pi N_1}{R_2}\right)\sin\left(\tan^{-1}\frac{L_2 2\pi N_1}{R_2}\right)..(20)$$

Equation (20) states that, when the circuits I. and II. are in resonance, the moment of the continuous force, which acts to deflect the system, the ring having a particular position, so that the coefficient of mutual induction between it and the coil of the instrument is M_1 is directly proportional to n, the number of turns in the coil of the instrument, to M^2, the square of the coefficient of mutual induction between circuits I. and II., to I_1^2, the square of the current in circuit I., and inversely proportional to R_2^2, the square of the resistance of II. The moment of the force is nearly proportional to N_1^3, the cube of the frequency, but not exactly so since N_1 enter into the product of the sine and cosine terms.

With large deflections, H, which invalues M_1, must also change considerably, though for small deflections the change in H would be negligible. The instrument cannot, therefore, strictly speaking, be called an alternating-current galvanometer, but only an extremely sensitive alternating-current detector. Nevertheless, for the deflections used and for the class of experiments in which the instrument is serviceable it may, for all practical purposes, be assumed that the deflections are proportionable to constant quantities which can be determined. In dealing with rapidly oscillating currents there are so many uncertain factors to deal with that only very rough quantitative results can be obtained, and the uncertain factors which exist in regard to the law of the deflections of the instrument are the least important of those with which one has to deal.

If in equation (20) the value of $M^2 = 4\frac{S_1^2 S_2^2}{C^6}$ (see Eq. 8*b*) be substituted, we obtain equation (21), which completely expresses the factors upon which the deflections of the instrument depend when the induction is between circular loops and the two circuits are in resonance. Calling the deflection φ and letting H_1 be a constant,

$$\varphi = H_1\frac{S_1^2 S_2^2 I_1^2 N_1^3 n}{C^6 R_2^2 R_2}\sin\left(\tan^{-1}\frac{L_2 2\pi N_1}{R_2}\right)\cos\left(\tan^{-1}\frac{L_2 2\pi N_1}{R_2}\right).....(21)$$

RESONANT CIRCUITS. DISTANCE BETWEEN CIRCUITS VARIED.

An experiment was made to obtain the deflections with the circuits constant and distance between circuits varied, and a comparison is given of the ratios of actual deflection with the ratios of calculated deflections. In the calculations the fact that $\frac{d M_1}{d\varphi}$ (see Eq. 9*b*) varies is neglected, which would make all of the calculated ratios somewhat too large.

Two circular circuits of 40 cm. diameter, made of No. 16 wire, with short leads, were employed. The condenser of the inducing circuit consisted of two sheets of tinfoil, 34 x 20 cm. The condenser of the receiving circuit was made of two sheets of tin foil separated by a glass plate, and capable of being rolled up on brass rods, so that the capacity could be easily varied.

The smaller instrument was used with a coil of forty-four turns of No. 42 wire. The coil of this instrument has a small diameter (6.5 mm.), and consequently has very little self-induction, so that, put in the small loop, it only slightly increases the natural period of the circuit of which it is a part. The current was supplied to the inducing circuit by the secondary of the transformer, the spark gap being about 2 mm. The circuits were brought to resonance by varying the capacity of the receiving circuit, and readings were taken with the two circuits at various distances from each other.

TABLE.

Metres Between Circuits.	Mm. Deflection.	Ratio $\frac{C_1^6}{C_2^6}$	Ratio $\frac{D}{D}$
2.5	45 5	2.98	2.8
3.	16.2	2.52	2.19
3.5	7.4	2.23	2 18
4.	3 4	3.8	3.2
5.	1.07	1.77	1 34
5.5	.8	....	....

The first column of the table contains the distance between the circuits in metres; the second, the deflections in millimetres, each being the average of three readings; the third column contains the inverse ratios of the sixth power of the distances; the fourth column the ratios of the deflections, each value being related to the value immediately following.

This experiment gives only a rough confirmation of the formula deduced above. It must not be expected that readings made with an instrument of this kind, when the deflections are produced by oscillatory currents, should have the consistency of galvanometer readings. The slightest variation in the separation of the balls of the spark gap in the inducing circuit or variation in the strength or direction of the air blast was found to produce considerable variation in the deflections, all other conditions remaining the same. In actual practice oscillatory currents are hardly ever pure sine waves. Numerous harmonics are generally superimposed upon the fundamental oscillations. Furthermore, the maximum difference of potential to which the condenser in the primary circuit becomes charged is dependent, not alone upon the length of the spark gap, but also upon the nature of the discharge itself between the balls. When the discharge is in the nature of an arc, the condenser is not highly charged and the oscillations are irregular and feeble. The unavoidable discrepancies of all the readings taken are to be accounted for, in the main, by the impossibility of assuring that the oscillations are uniform in character.

As was stated in the introduction, the experiments described are not attempts to solve important commercial problems. The distance limitations of the method as a mode of communication can be partially assigned.

With the loops which we employed a deflection of 124 mm. was obtained at a distance of 350 feet. At 700 feet the deflections would have been 2 mm. Had we constructed a transformer that would give a spark of 1 inch, the distance could have been increased to about 1600 feet. By using the more delicate instrument described above this distance could probably have been trebled; by using larger loops and wire of smaller resistance in both circuits, the distance could perhaps have been increased to some miles. By forced oscillations in the inducing circuit, and by other improvements, we could have probably gone further still, but inevitably the fact that induction effects diminish as the cube of the distance would soon have put distance limitations upon all efforts at wireless signaling by loops.

The experiments are merely of scientific interest. They give, in a manner, by numerical relations, confirmation of the much-talked-of electrical harmony. Circuits can literally be tuned to accord with each other, as a violin is tuned to accord with a piano. The method is different, and the medium of propagation is no longer the air. The ether again comes up visibly to the scientific mind. Call it a "convenient mathematical fiction," if you will, but the student of electricity sees tubes of magnetic induction going out from one loop and cutting the other, and is able to say beforehand just what currents will flow, and just what phenomena will be manifested.

Water Power for Tacoma.

The Chambers Creek Power Company, of Tacoma, Wash., is preparing to install a hydraulic electric plant of 3000 horse-power in the early spring of 1898. Chambers Creek lies 8 miles from Tacoma, and has a fall of 115 feet available for power purposes. The flow is about 200 foot seconds. The power plant lies but a short distance from Puget Sound, and will contain for the initial installation three 750-kw three-phase generators direct coupled to impulse wheels. The transmission for Tacoma city limits will be at a pressure of 10,000 volts. The Chambers Creek Power Company will deliver power to several street railway companies, likewise to some large manufacturing interests and machine shops. Almost the entire capacity of the power plant has been contracted for, in amounts ranging from 100 to 500 horse-power. Mr. T. O. Abbott, Vanderbilt Block, Tacoma, Wash., is president and manager of the company, and Mr. Eleazar Darrow, Spokane, Wash., is the engineer in charge.

Electricity in Placer Mining.

The electric motor has been adopted by some users of steam shovels and similar mining apparatus in Colorado. The use of motors for such apparatus is readily made the means of a considerable saving, as the current can be generated oftentimes by water power, and at other times in places much more suitably located for the supply of fuel than are the shovels and dredges themselves.

Extension of the Electric Railway System in Dublin.

BY ALBERT H. BRIDGE.

The electric tramway system of the city of Dublin has been one of the most successful in the United Kingdom. It was opened in 1896, with a length of about 8 miles, for the most part double tracked. The power is supplied from a station placed at one end of the line, and is transmitted as three-phase high-pressure alternating currents to several sub-stations, where synchronous alternating current motors drive ordinary 500-volt railway generators. The original power station was equipped with three 250-hp Babcock & Wilcox boilers, four 150-hp Willans compound engines, two Thomson-Houston 100-kw four-pole 500-volt generators and two-six-pole 120-kw three-phase 2500-volt generators.

A double-track extension 3 miles long has just been completed by the British Thomson-Houston Company, the representatives of the General Electric Company of America. The new line runs through a suburban district, studded with residential villas of a superior class. The track follows the line of the sea coast from the city limits to the terminal at Dollymount. The gauge conforms to the Irish standard of 5 feet 3 inches. The power generating equipment, situated at the Dollymount end of the line, is erected in buildings formerly used for stables and car houses, altered over to suit the new requirements.

In the power house there are three Babcock & Wilcox boilers, each with a heating surface of 2200 square feet, and a grate area of 44 square feet. A Green economizer of 160 tubes in placed in the boiler house, so fitted to the main flue that the gases on their way to the stack may be sent either through the economizer or shunted around it. The stack is octagonal in cross section, the inside diameter being 7 feet and the total height 112 feet. It is lined with fire brick for a height of about 50 feet.

Water is supplied to the boilers by two direct-acting Worthington steam pumps, each capable of delivering 2200 gallons of water per hour against the working pressure of 150 pounds. A cast iron water tank, with a capacity of 10,000 gallons, has been placed in the boiler house, and to provide against the failure of the township water supply a storage tank of 38,000 gallons capacity has been excavated on land immediately adjoining the engine house. The feed-water piping is in duplicate throughout, and so arranged that the water can be taken direct to the boilers or through the economizer. The steam headers are in duplicate, built of lap-welded steel tubing, with cast steel flanges, the requisite number of valves being provided so that either header may be worked independently. Steam separators are provided immediately over the main valve of each engine.

There are three engines, built by McIntosh & Seymour, of the horizontal tandem compound type, with cylinders 11½ and 12 inches in diameter by 17 inches stroke, designed to run at 200 revolutions per minute. These are direct-coupled to six-pole 150-kw 500-volt generators, supplied by the British Thomson-Houston Company. These generators are guaranteed to carry an overload of 25 per cent. above their rated capacity for two hours without overheating, and to carry fluctuations from zero load up to 50 per cent. above the rated load, without any shifting of the brushes or without injurious sparking at the commutator.

The switchboard is of the ordinary construction, with a panel for each generator, provided with quick-break switches, magnetic cut out and feeder panels, each of which carries circuit breakers and ammeters for two circuits. There is also a total output panel with Thomson recording wattmeter, and a leakage panel, according to the Board of Trade requirements. The power house is lighted by arc and incandescent lamps, supplied from a marine type generating set, consisting of a high-speed vertical engine direct-coupled to a four-pole 10-kw generator, running at a speed of 650 revolutions per minute.

An overhead traveling crane of 6 tons' capacity runs the whole length of the engine room, with lifting and traversing gear arranged to be worked by hand from the floor level.

The line construction is of the standard overhead span wire type, supported by poles 29 feet 6 inches in length, made up of three sections of 5-inch, 6-inch and 7-inch tubular steel, with overlapping joints shrunk together. The poles are placed at an average distance of 120 feet apart, and carry two trolley wires of hard-drawn copper wire, No. 0 B. & S. gauge, divided into half-mile sections. Two main feeders run out from the power station and are looped at intervals into switch pillars. At each of these pillars they are provided with six quick-break switches, so arranged that any section of the line or feeder may be cut out without interfering with any other section of the system whatever. Each of these switch pillars also contains a magnetic blow-out lighting arrester, connected to the trolley line. The track has been relaid with 7-inch girder rail and bonded with Chicago bonds of 0000 copper 30 inches in length. It is also cross bonded at short intervals. There are no grades or curves of any serious nature throughout the entire length of the line.

Fifteen double deck motor cars have been equipped for this service, accommodating fifty-four passengers each, of whom twenty-five are seated inside. The cars are mounted on Peckham cantilever extension trucks, resting on 33-inch wheels, each truck being fitted with a fender at either end. Instead of having fuses on the car one of the platform switches is replaced by a magnetic circuit breaker. The controllers are of the standard K-2 series parallel type, fitted with the usual interlocking arrangements and the emergency stop position, whereby the motors can be short circuited for rapid retardation. The motors are of the well-known G. E. 800 size, there being two of these on each truck.

It is proposed to extend the line shortly for a further distance of about 6 miles. Ample room has been left in the power house to provide space for further machinery, which will be called for when the line is extended.

The Meeting of the Electrical Committee of the Underwriters' National Electric Association.

The Electrical Committee of the Underwriters' National Electric Association held its fifth annual meeting in New York City for the purpose of discussing several points of interest in the construction and installation of electrical apparatus. The first meeting was held December 6 at the National Board rooms, 156 Broadway, New York City. At this meeting a committee was appointed for conference with those of other associations on the subject of thermo-electric fire alarm rules and regulations. The secretary reported the adoption of the national electrical code by the various Boards of Underwriters, and also by different associations represented in the national conference. It was moved that the committee urge city inspection departments to adopt the national code as a part of their ordinances, and it was resolved that the executive committee of the National Board of Fire Underwriters consider the advisability of encouraging the establishment of municipal electrical departments for the regulation and control of electrical hazards. The question of publication of a list of approved fittings and devices was discussed, and it was evidently the sense of the committee that such a list should be published, after having been approved by the various insurance inspection departments.

At the meeting of December 7 detailed specifications for approved fittings and devices were discussed, as were also the specifications for wire tests. It was voted to make the breakdown test of five minutes' duration, and to refer this matter to the American Institute of Electrical Engineers, with the request that they express an opinion as to the propriety of this time limit. It was also voted that the bureau for a year make the insulation test on wires with a limit of 100 instead of 1 megohm per mile, and report the results of these tests at the next annual meeting.

At the meeting of December 8 it was voted that the subject of regulations for the installation of kinetoscopes and similar devices be referred to a committee which was appointed. Another committee was appointed to report upon the improvements which can be made in the construction of sockets, and another for the drawing up of specifications and requirements for testing flexible cord. It was voted that it was the sense of the meeting that a meeting of the full association should be called previous to the next meeting of the committee, no such meeting having been held for three years. A committee was appointed to confer with the New York Fire Department in order to obtain so far as possible a uniformity of rules between the Underwriters and the municipal department. A committee of five was appointed for the purpose of investigating and reporting on the hazards of transformer breakdowns. Another committee was appointed to report suggestions for rules to govern the installations of telephone, telegraph and similar wires.

After extending a vote of thanks to the New York Board of Fire Underwriters for the use of their rooms, the meeting adjourned.

The Tendency of Central Station Development—III.

In the early days of central station building, especially in America, the doubtful character of the financial returns rendered investors timid and necessitated the construction of stations in as cheap a manner as possible. With the gradual settlement of the business on a more and more firm basis, the feature of low first cost has been seen to be very poor economy. The tendency is now strongly in the other direction, the added cost of the highest grade of equipment paying good returns, owing to the reduced maintenance, depreciation and attendance charges.

Particularly in the last detail, namely, that of attendance, there has been a strong attempt to reduce the running expenses. A slight change sometimes in the construction may enable a plant to be run with one less man, the saving effected being perhaps $1000 per year, which is a good investment on a great many thousand dollars of the added first cost. So strongly has this fact become impressed upon the managers that there is often an unconscious bias in their minds toward the more expensive of two alternative plans or machines, regardless of the other relative merits. Every effort is made on the part of the more progressive toward the elimination of manual labor. Coal is handled from the cars or boats by conveyors to bins located at such a point that the coal will drop by gravity to the boiler room floor. Mechanical stokers are as yet rather rare, but are rapidly coming into wider favor. The use of larger units and the unification of the system whereby arc lights, incandescent lights and motors can be run from the same generators and distributing mains, helps in the same direction. The item of appearance alone is given considerable study, and switchboards particularly are made in most elegant and attractive designs. The economy of such regard for appearance is oftentimes hard to see, but its indirect influence on the operators in the pride which they take in their machinery and the care with which they control it is a direct result of a handsome equipment.

With the growth of systems, the service which was in its early days rather fitful and liable to shutdowns at any time has become more and more reliable, and the feeling has grown up that the shutting down of a line is something almost criminal. In the aim to provide against accidental interruptions, the independence between the different boilers, engines, dynamos, etc., has been done away with, and a sort of trunk connection has been effected at all parts of the system of transforming heat into electrical energy. The boilers are interconnected by steam headers joined at several points to other steam headers connected to all the engines, so that the giving away of the steam piping at any one point affects at the most one engine or one boiler. The interconnection by mechanical means between the engines and the dynamos has become difficult, owing to the practice now adopted of direct coupling, but the dynamos are made to work in parallel on a common set of bus bars, whereas formerly they, in alternating systems, at least, were almost universally independently worked. Trunk lines of feed-water pressure supply pipes are used, which may be fed from any one or more of the pumps, and may in turn feed any one or more of the boilers. Forced draught flues are similarly arranged with several blowers, any one or more of which may be operated at will. Exhaust headers of the same design are used, connecting all the engines with all the condensers.

The losses in small inefficient auxiliary steam-driven apparatus are aloso being remedied. Reciprocating steam pumps for the maintenance of a vacuum or for water pumping use a ridiculously large amount of steam for the work they accomplish. The simple duplex pump so frequently used provides, of course, no chance for expansion. the steam being admitted the full length of the stroke, very often throttled considerably, and the consumption being still further increased by the large clearance common with such pumps. The pumps are run at reduced speed, and the condensation still furthers adds to the losses. The obvious remedy for these losses is the driving of all auxiliary apparatus by electric motors, whereby the high steam economy of the main engine may be realized with only a small percentage loss in the double transformation.

The boilers, as a rule, depend for draught on the ascensional power due to the heat retained in the gases after leaving the boilers, which is, of course, greatly reduced by the efficient extraction of the heat of combusion. The waste of several hundred degrees of heat in the flue gases to produce the extremely small power required for forcing the gases through the fire beds is a foolishly uneconomical proceeding. The use of a small motor driven fan for accomplishing the same result not only allows a great part of the heat of the flue gases to be extracted by increased heating surface, superheaters and economizers, but avoids the expense of high and costly stacks, and allows on sudden emergencies a great increase of the rate of steam production of the boilers.

The use of condensing engines has for a long time been considered possible only where a liberal supply of cold water for condenser cooling purposes is available, but of late several systems have been developed whereby the cooling is effected by what are called evaporative towers, in which the steam under so-called vacuum pressure is condensed by the evaporation of an equal amount of water on the surface of the condenser, the moisture being rapidly removed by the aid of a fan or blower. Other economies are effected by more careful lagging of boilers, steam pipes and engine parts, and by greater care in the packing of valves, pistons, etc. The losses due to valve and piston leakage are so hard to determine or even discover that they are often far more serious than is suspected. The use of multiple expansion engines reduces them somewhat, as steam leakage through one cylinder is utilized in the other or others, and in the case of leakage in the high-pressure end the energy lost thereby remains in the steam for further use.

The serious thermo-dynamic losses in steam boilers and engines, even with all these savings, are so great that many able designers are working hard on the perfection of the gas engine for electrical generation purposes. Such engines are as yet hardly used at all in this country, but have come into some considerable use in England, although their advisability is still considered an open question there. That they are capable of increased economy over steam engines there is but little doubt, but their most serious disadvantage is in the point of speed regulation. For the driving of constant potential direct current machinery this may be and is remedied by the storage battery, which has not as yet come into extensive use in alternatng current systems, although the rotary converter promises to make accumulators almost as valuable in alternating as direct current generation. The accepted gas engine with the Otto cycle, giving one stroke per two revolutions of the engine and exhausting gases at a pressure of many pounds above the atmosphere, and with a large residual heat energy, seems to be capable of considerable improvement, if as great efforts are made in this direction as have been made in the development of the comparatively more highly developed steam engine of the present day. The compound gas engine has lately been mentioned, and a high thermo dynamic efficiency has been reported, but it has not as yet come into use. The gas engines of this country are very limited in point of size, the largest single cylinder engine being, as a rule, well below 100 horse-power, the further increase in size being effected by a mere duplication of the cylinders. The construction of gas engines, comparable in size with steam engines of high economy, if such engines can be built, should show remarkable results, as the advantages of increased size would apparently be greater in the case of the gas than that of the steam engine.

In the matter of central station building construction there is a general tendency toward the standardized construction of large pumping plants, namely, the erection of a main engine room floor considerably above the ground level, leaving a large chamber below the floor level for the installation of all piping, wiring and often of auxiliary apparatus. The foundations are carried up to the floor level for the main units, and very often also for the air pumps, although many recent stations are placing the latter on the lower level. By carrying all steam pipes, exhaust headers and auxiliary pipes and wires below the floor level, the main engine room is given a highly attractive appearance, and a free space overhead is left for the operation of the traveling crane, which is an almost universal accompaniment of the modern electric plant. The floor, elevated in this way, is sometimes constructed, as are those of modern steel buildings, with steel I beams for girders, and brick and tile arches spanning the intermediate spaces. Of late another type of floor has come into some use, consisting of solid concrete and cement, cast, so to speak, over false work boxes in such a way as to form one integral mass of main girders from column to column, auxiliary narrower girders between the main girders and the floor over all. These concrete girders are strengthened in their lower parts where the strains are those of tension by steel rods, generally of square cross section twisted, or steel cables, or plain steel rods with projections for catching the concrete, simply placed in the slots or grooves between the boxes before filling with concrete.

Electric Traction.*

BY CLOYD MARSHALL.

Electric traction is now and has been for some years the foremost branch of electrical industry in the United States, and present indications point to its growing importance. Already there are 13,755 miles of electric lines, and the capital invested has reached the great sum of $846,130,000. Nearly every city and village in the country is provided with electric cars, but from now on the development will be in the more important field of heavy traffic. By this term is meant the conditions of service on the elevated and underground roads, the interurban lines and the systems operated under steam road conditions. The elevated service has a very limited application only in the largest cities, but on these lines the solution of some of the problems there being worked out will be of material assistance on the surface lines. It has been found that electricity is much more economical and satisfactory than steam in such work. The Metropolitan and Lake Street Elevated lines in Chicago and the Liverpool overhead road have demonstrated this point. The equipments are all very similar, except that gearless motors are used at Liverpool.

One notable departure in elevated road practice is the adoption of the Sprague system by the South Side Elevated Railroad Company, of Chicago, which now uses small steam locomotives in operating its cars. There are a number of new ideas embodied in the apparatus and its arrangement on this system. Each car is equipped as a complete motor car, having a motor on each truck, a controlling mechanism and an air compressor automatically operated by a small motor. The feature which stamps originality on the system is the possibility of joining any number of these cars together, each doing its own part of the work in propelling the train. The controlling mechanism can be governed from any vestibule on the train and all parts act in synchronism.

The advantages of such an arrangement are apparent. Trains of any length can be run with the motors always working at an economical point, regardless of the number of cars. Cars can be put on or taken off at times of heavy or light service, and at convenient places, for changes can be quickly made. The power for acceleration, which is so greatly important in elevated road service, is greater with this system than with any other, for the weight of each car and its load is available for tractive effort. These advantages have been secured at the price of complication, and in multiplying the number of pieces of automatic mechanism the chances of breakdown and cost of maintenance are increased. The use of small motors will not make a marked difference in the current demand, for the difference in efficiency between a 50-hp motor and a 200-hp motor would be little more than 2 or 3 per cent. However the cost of power is not such a great factor on elevated roads as on surface lines.

To test the real merits of the system it will have to be subjected to actual service for a considerable period and records compared. Even though it may be more expensive, the flexibility, convenience and higher average speed of the Sprague system might so commend it to the public as to greatly increase the patronage of the road. If it is a success, it will be a great one, and its adoption by the other elevated companies will be only a question of time.

Electric traction is now passing through an evolution, and it is difficult to tell where the limitations will be. The short lines in the cities have been extended into the suburban districts, and now connecting roads have been constructed to unite the systems of neighboring towns. The Cleveland suburban and interurban lines are examples of such extension; five lines run from the public square to cities 20 to 30 miles distant. The steam roads are fighting these lines by making nominal rates, but the clean and frequent service of the electric cars more than compensates for everything else.

The apparatus and equipment for electric traction has so far been designed to replace horse power and for the comparatively short lines in the cities. For interurban service, where higher speed and more power are required, the motors have been enlarged, the car bodies strengthened and the double trucks adopted. With plans for the long lines between cities and high speeds in competition with the steam roads, it is evident some more important changes are needed, and the apparatus should be designed to conform with steam road engineering. The conditions of such service are very exacting on the equipment.

The first question is: Can the electric lines compete with the steam roads? It has been the experience near Cleveland, Boston, Hartford and Minneapolis that the trolley roads, parallel to the railroads, get the lion's share of the traffic, and this in spite of the slower speed. The success lies in that the intervals between the trolley trains are short, the schedule is unvarying, the cars are clean, cool in summer, warm and well lighted in winter and stop at convenient points. Most of the interurbans are carrying mail, small packages and express matter, and this affords a considerable source of income. Of course the steam roads do not want the expense of adopting electric traction, but if the business turns to the more convenient, cheaper and popular trolley car, something must be done.

One after another the equipment questions are being solved. There is no longer a doubt but that the electric motor can perform the work of the locomotive. It can climb steeper grades; the absence of reciprocating parts makes a greater speed possible, and the fact that the source of power is external enables it to have a greater capacity and pull heavier loads. The motor does not require skilled labor for handling and repairs, so that the personal factor in the steam engine is much greater than with the motor. Greater acceleration can be attained with the motor; such results as were obtained at Schenectady were never dreamed of with the locomotive. The smoother running of the motor is easier on the track and all equipment. One other difficulty with the locomotive is that units of motive power are not available for all kinds of work. Sometimes locomotives are used in passenger service which requires a half, a quarter or a tenth of its power. The steam motor car, recently built at Schenectady locomotive works, is evidence of the fact that such small units are needed in steam road work.

Now, as to the coal bill. With the electric line the energy is generated in the most economical manner, while each locomotive is a little generating plant of itself. With express locomotives operating under favorable conditions, the coal consumption is about 4 pounds per horse-power per hour. One of the New York Central express engines made a record of 3½ pounds; for local traffic, 5 pounds is a good average, and for freight 5 to 10 pounds is the usual consumption, without considering the coal consumed in starting, banking and drawing the fires. With large stationary engines a hp hour can be generated with 2 pounds of coal; some, under very favorable conditions, take but 1.5 pounds. Coal consumed in the power house is very much less expensive in first cost and handling than that on the locomotive. One of the large mills in New England reported the yearly cost per horse-power to be $11.64, and the manager of the General Electric Company, Limited, stated in an English paper that the cost per horse-power per annum of running a 600-hp compound condensing engine at the Peel Works was as follows, with coal at $1.68 per ton:

Coal	$4.76
Labor	2.34
Oil and supplies	1.42
Repairs	.12
Total	$8.64

Such figures as these, of course, are not realized in street railway stations, but they show what can be done. The *Street Railway Review* has been collecting some data on the cost of power house operation, and from the figures I find that the average for ten of the principal street railways of the United States is .885 cents per kw hour, or $20.54 per horse-power for 310 days of ten hours each, or $43.62, 365 days, 18 hours. This includes fuel, labor, supplies and repairs, but not interest and depreciation. The fuel bill ranges from 36 to 73 per cent, the average being 54.1 per cent. of the power house operating expenses. As a rule the cost of fuel for an electric system is about 5 per cent. of the operating expense, while on steam roads it is 10 per cent. Whenever water power can be utilized or the power station located near coal mines or culm heaps, in generating power the electric lines then possess very great advantages over the steam roads.

A study of the question will reveal the facts that for electric lines the power can be generated and applied more economically than on steam roads; it is the economic transmission of the energy which is the difficult problem. Some writers on electric traction have

* A paper read before the December meeting of the Chicago Electrical Association.

neglected to fully consider those difficulties and have reached impractical conclusions. As far as an engineer can see into the future it is improbable that electricity will supplant steam for general railroading purposes, but there are some departments of the work where the adoption of electricity will be a great advancement. In thickly settled communities, as parts of the New England, North Atlantic and Central States, the railroads will be forced to make changes in their service to successfully compete with the parallel trolley lines. If the example of the New York, New Haven & Hartford Railroad Company is followed this can be done. Service on a private right of way enables high speed service to be given faster than would be permissible on the public highways. Colonel Heft states that in consequence of this change the traffic between Berlin and Hartford has increased 400 per cent. since the opening of the line. It is the old story of better, though costlier, service, being more popular and profitable. It is cheaper to travel by canal than on the railroads, but we can hardly consider the canal a competitor of the latter.

Although the railroad papers are persistent in decrying the usefulness and adaptability of electricity to steam railroads under any conditions, yet it is significant that they devote much space to the subject, and many of the leading railroad engineers are making a careful study of it. The Illinois Central was instrumental in having the Schenectady acceleration tests made, which were so remarkable in their results. The engineers of the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul were present, and admit that they are getting posted on electric traction. In personal interviews they disclaim any intention of their companies adopting electric traction, yet, they say, under some conditions it would be advantageous to do so.

It seems that the day is near at hand when the electric locomotive will find wide application within the limits of the great cities, and the steam locomotives will be outlawed. At present each railroad track is an unclean strip through the city, and the smoke, soot and dust make contiguous property undesirable. As a result the railroad routes are lined with huts, hovels and tumbledown warehouses. The handsome and costly stations erected by the companies are begrimed and soon rendered unsightly. For public health and the improvement of the city the presence of the locomotive within the city limits should be prohibited. The adoption of the electric locomotive from the limits to the stations would do away with the smoke and filth, and enhance the value of property along the railroad tracks. The railroad men would raise a cry about the dangers of the third rail and the complications at switching points. The same objections, with greater force, have been raised against the use of the trolley in the streets, and the Union Loop and the South Side Elevated, at its yards in Chicago, have succeeded in operating some complicated third rail work.

For high-speed work the trolley is not suited, the danger limit being about 40 miles an hour, although some experiments have exceeded that figure. One of the large electric companies spent much time and money experimenting on a small Pennsylvania road, and some record tests were made with the trolley. High speed was made for a considerable distance, one mile being covered in fifty-seven seconds, but the trolley wheel jumped the wire, tore down the line and broke off several poles at the ground, also the top of the car was damaged. It is obvious that the trolley will not do for this work, and we must turn to the third rail. Fortunately the third rail for railroad work costs about half as much as the trolley. It should be protected in some way, so that anyone crossing or working on the tracks will not be subjected to danger, and tools and bars will not short circuit the section by careless handling. Such a system is on the market, though it has hardly passed the experimental stage. Another system which might be worked out would be to have the rail sectioned in lengths of 3000 feet, more or less, as convenient, and energized like the underground magnetic system.

With the present equipment it seems that 500 or 600 volts at most is the limitation of the direct current motor, and long lines can only be operated by placing power stations at frequent intervals, say 10 or 12 miles apart. The transmission at this voltage involves enormous loss or great expense for copper. On one road recently tested the voltage varied from 525 volts near the station to 240 volts at the end of the line, 7 miles distant. It is obvious that for transmission alternating currents must be employed. How necessary high voltages are may be seen from a little calculation on the cost of copper for line wire. Mr. Stillwell gives the cost of copper required to deliver one horse-power at motor shaft, 10 miles from the generator, allowing a 20 per cent. drop and copper 15 cents per pound, at 500 volts, $780.75, and at 10,000 volts, $1.95. Thus it is seen that it costs 400 times as much to furnish copper at 500 volts as it does at 10,000. A voltage of 10,000 is well within present engineering practice.

With apparatus in the present state of development, the best plan is to generate an alternating current at the place of most favorable conditions, and transmit at high voltages to sub-stations, where rotary converters will change it to a direct current and supply sections of line of medium length. It is generally believed that alternating current motors are out of consideration for traction purposes, and it is true that the experiment has not been successful on account of the low starting torque and lack of regulation; but the improvements which have of late been made go far in perfecting this machine. As an example of what can be done reference is made to the 400-hp two-phase induction motor installed by the Westinghouse Company at the station of the Buffalo & Niagara Falls Light & Power Company. These machines require practically no attention, having no commutator, collector rings, brushes or any sliding contacts.

The speed of multiphase motors may be regulated by changing the number of excited poles, the speed being inversely proportional to the number of pairs of poles; also resistance in the armature circuit will have the same effect.

In some recent experiments in Germany it was reported that a single-phase motor, with auxiliary coils of a few turns, causing a phase shifting, gave a starting torque two and a half times the normal in the short-circuited armature parallel to the exciting coils. Otherwise the machine was the same as the ordinary single-phase motor, and no starting resistance was necessary in the main circuit. Of course this starting torque is not so great as that obtained with the series motor, but the experimenter stated that it could be increased. It is desirable to transmit a single phase current on one wire, and use a phase shifting or splitting device on the car. If the third rail construction is adopted a fourth rail would not be objectionable, as is the second trolley wire, and a polyphase motor can be used. There are many advantages and much economy in the use of alternating currents, and their utilization for railway work depends on the designs of the motors.

The application of electricity to heavy traction promises to be its greatest field, and as the past year has been fruitful in some striking and successful examples, the coming year will solve many important problems in this line.

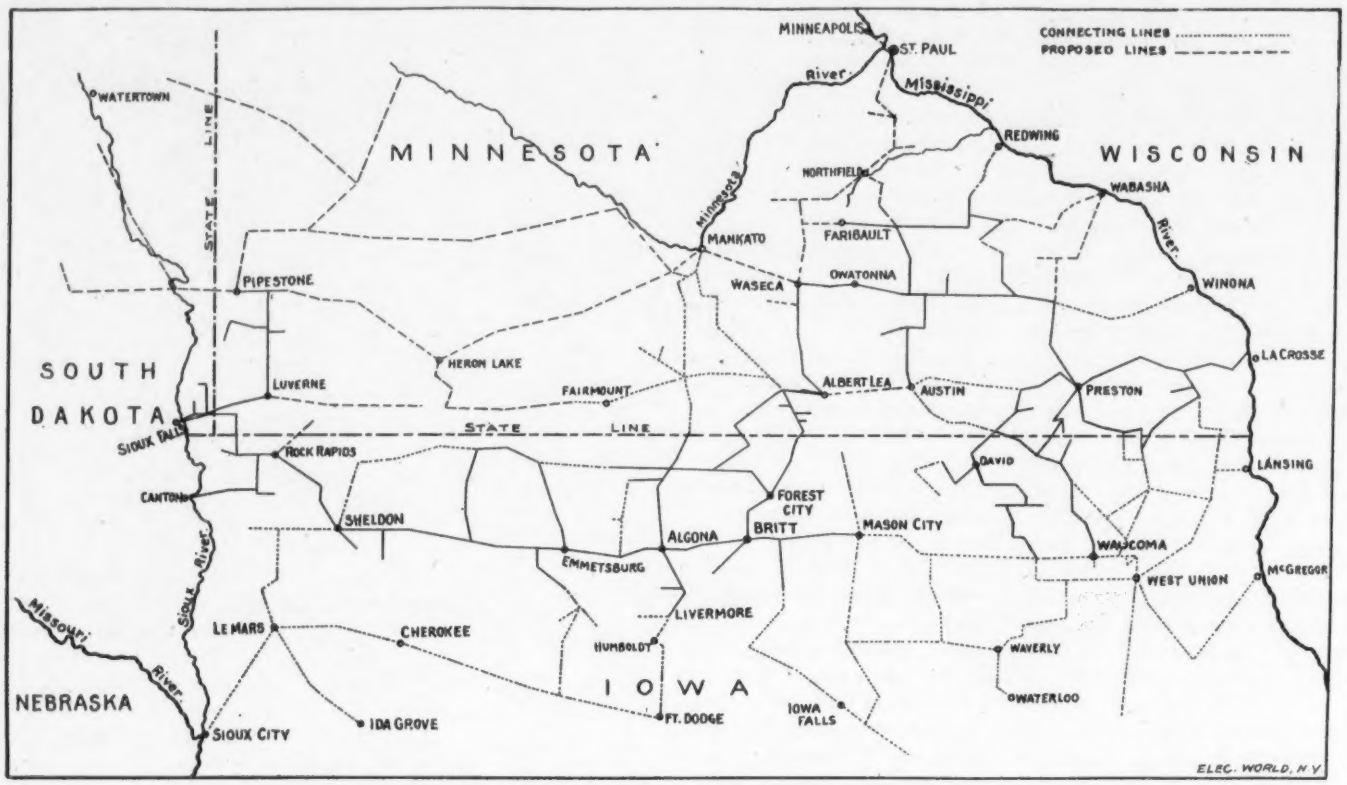
Meeting of the American Institute of Electrical Engineers.

At the last regular meeting of the American Institute of Electrical Engineers, held December 15, a paper was presented by Mr. Thorburn Reid on "Sparking: Its Cause and Effects." Among other things, Mr. Reid stated that the most important step forward in the theories of commutation and the nature of sparking was taken when the reactance of the coil under commutation was recognized as the greatest obstacle to perfect commutation, and the duty of overcoming this reactance was assigned to the E. M. F. set up by the cutting of the lines from the field. This step stopped just short of a complete explanation of the phenomena, due to an erroneous idea that injurious sparking was due to the current jumping across the gap between the brush and the receding segment. Mr. Reid's treatment of this point tended to show that the harm was done before the segment left the brush, the thin blue spark in itself being harmless, and the real source of injury being an increase of current density at the edge of the commutator segment, which heated the latter often to the melting point. The subject of contact resistance was considered, and the conclusion reached that perfect commutation can only be practically secured by making the contact resistance sufficient to render the impedance of the coil comparatively negligible. After the close of the discussion, Mr. William J. Clarke gave an exhibition of the transmission of signals by Hertz waves. No effort was made to show the effect at a distance, the transmitter and coherer being both within the building. An amusing incident was afforded by the de-coherance of the ice in the water pitcher on the speaker's desk just at the time when the signals were about to commence, and the audience was carefully listening for the ticking of the sounder.

The meeting of January 25 will be devoted to the question of standardizing generators, motors and transformers. The policy of undertaking this work, as well as the technical problems involved, may be discussed. Communications upon the subject are invited, and may be sent to the secretary in advance of the meeting.

Western Electric Telephone System.

In the country districts of Iowa, Southern Minnesota and South Dakota there has grown up during the last two years a telephone toll line system which is probably the largest of its kind independent of the Bell companies. This system, the general offices of which are in Britt, Ia., has now in operation about 2600 miles of line, which is being constantly augmented by the addition of new lines and the extension of old ones. The accompanying map shows the main lines and the more important of the cities reached. The main lines, as may be seen, do not run into the large cities in or near the district covered. The company has found that there was more money to be made between the small country towns and villages than between the larger places. The system was organized in May, 1895, and the entire mileage has been constructed since that date. The lines are built in a much cheaper way than those of the Bell systems, the business necessitating low rates, which would be out of the question with expensive construction. The rates for five minutes' use of the line are in general 20 cents to stations within the county; 30 cents to stations within adjoining counties; and 40 cents to stations beyond adjoining counties.



Map Showing Lines of Western Electric Telephone System.

The line construction consists of 25 and 30-foot poles, measuring 5 or 6 inches in diameter at the top, carrying No. 9 galvanized iron wire, the circuits being earthed for return. This construction carries the voice with perfect satisfaction over distances up to 200 miles without repeating, the use of the wires over longer distances being discouraged on account of the better paying features of the short distance work. The instruments are those made by the Standard Telephone & Electric Company, of Madison, Wis., with the exception of the Milde transmitter, which is imported from France. The stations are equipped on the bridging system.

The company does not, as a rule, undertake the local exchange business. Its intention is to encourage the construction of exchanges by local stockholders, which exchanges use the toll lines of the company for through service. Experience has shown that local parties are ready and willing to take hold of the local exchange construction and under the direction of the toll company, the local construction is easily made of a satisfactory nature for the long distance work. The problem of the operation of the offices in the smaller towns is also helped in this way, as it often is not necessary to hire special operators, and the local owners on account of their personal interest see to the proper operation of the lines. In towns too small for the installation of a central office, the telephones are put on the line wire, a small yearly rental being charged for the local business and the regular toll rates for the interurban work. There are now in operation several hundred of these telephones, besides about 2000 'phones on the central offices. It is anticipated that there will be at least 6000 telephones on the lines at present in use within the next three years. The company's officers have been happily disappointed in the matter of storm interferences and repairs. The worst sleet storm that has occurred as yet did not damage the lines to the extent of more than $100.

The original intention was to make a specialty of supplying the farmers with telephone service, but it has been found rather difficult to place this branch of the business on a paying basis, although it is anticipated that as the system grows and the need becomes greater this will become an important part of the system. The system will eventually comprise in all probability all metal lines of copper for use between the large cities and the small towns. These, however, it has not paid as yet to take up, owing to the greater need of the cheaper lines in the country districts and the trunk lines of the Bell Telephone Companies between the large cities. The latter are built in a very thorough way, costing from $300 to $500 per mile, while the lines of the Western Electric Telephone System cost only from $65 to $150 per mile. The expense of maintenance, including office expenses, repairs, etc., is found to be only about 50 cents per month per mile of line, which allows a very comfortable profit with the business that is obtained.

Independent Telephone Companies.

It is stated that there are over 1200 independent telephone exchanges in operation in the United States, representing an investment of between $20,000,000 and $30,000,000. Of these exchanges 173 are in Ohio, which State heads the list; Illinois follows, with 169; New York, 164; Pennsylvania, 147; Indiana, 142; Iowa, 139 and Michigan, 133. The Detroit Telephone Company, Detroit, Mich., heads the list with the largest number of subscribers, having no less than 6000. There are 2000-subscriber exchanges at Richmond, Va., and at Newark, N. J.

Water Power and Coal in France.

Our contemporary *L'Eclairage Electrique* states that 28,000,000 tons of coal are mined annually in France, while 38,500,000 are consumed. France therefore pays to the foreign countries annually about $30,000,000 for this excess of coal. The total water power in France is estimated to be 10,000,000 horse-power, which is about equal to the combined power of all the steam engines in the world, but at present only one-tenth of this water power is used.

Life and Candle-Power of Incandescent Lamps.

Since the one purpose of an incandescent lamp is to give light, the best lamp is that which gives maximum light at minimum cost. This is an exceedingly simple axiom and yet few users of lamps follow it out in practice. Lamps are repeatedly selected for long life irrespective of good, uniform candle-power. Lamps are often continued in use long after their candle-power has seriously diminished. The folly of such a course is so well explained in a recent publication issued by the General Electric Company, that it is deemed worth while to reproduce the greater part of it here.

An examination of the characteristics of an incandescent lamp will give a clear understanding of the principles applying to their selection and use. A theoretically perfect lamp would maintain its normal candle-power indefinitely, or until the lamp was broken. In practice the deterioration of the lamp filament causes a steady loss of candle-power.

The drop in candle-power is a characteristic of an incandescent lamp always to be borne in mind. The relative drop or loss of candle-power, other things being equal, determines the comparative value of different lamps. We may have a lamp that loses 50 per cent. in candle-power inside of 200 hours on a 3.1-watt efficiency basis. This type is almost invariably furnished by the inexperienced manufacturer, and there are many such lamps in the market. Considered from the standpoint of life only, such lamps are excellent, because their filaments deteriorate to such a degree that it is practically impossible to supply enough current to brighten them up to the breaking point, but no discerning station manager would want such dim lamps, even with unlimited life. As in the selection of incandescent lamps so in their use—the exclusive consideration of life leads to poor results. Loss of candle-power in a lamp sooner or later makes it uneconomical to continue its use.

There is no lamp yet made which is economical to burn over 1000 hours, and in the great majority of cases the limit is under 600 hours.

An incandescent lamp is nothing more than a transformer, receiving current and transforming it into light. After a certain time this transformer may lose 50 per cent. in efficiency, taking practically the same current, but giving only about one-half the light. A boiler or an engine suffering such loss in efficiency would be promptly repaired or replaced. The renewal of incandescent lamps is even more important. The old lamps jeopardize the customer's trade with their poor and expensive light. A customer cares little how efficiently a station is operated, but is much concerned about the quality of light furnished. At the present price of lamps, doubling the number of lamp renewals adds little to cost of operation, while it increases the lighting efficiency 40 per cent. to 50 per cent. Some stations attempt to correct the dimness of old lamps by raising the voltage, but this is bad practice, for the increased pressure damages every new lamp placed in circuit. These principles are carefully observed by many of the large lighting companies, and a force of men is employed to weed out and replace all dim lamps. Some such means of keeping the average life below 600 hours should be adopted by every lighting company that has any regard for the economical production of light or the satisfaction of their customers.

A simple method is to fix the average life at 600 hours or less, and then determine from the station record how many lamps should be renewed each month to keep the average life within this limit. The required number of lamps should be renewed each month.

If, for example, a station decides on an average life not to exceed 600 hours and the station records show that on the average 60,000 lamp hours of current are supplied monthly, then it would be necessary to renew $\frac{60,000}{600}$ or 100 lamps a month.

Poor regulation of voltage probably results in more trouble with customers than any other fault in electric lighting service.

Some central station managers act on the theory that so long as the life of the lamp is satisfactory an increase of voltge, either temporary or permanent, will increase the average light. The fact is that when circuits are fed even temporarily above their normal voltage the average efficiency of all the lamps on the circuit is permanently decreased, and if the station is on a meter basis, it increases the amount of the customers' bills.

Excessive voltage is thus a double error—it decreases the total light of the lamps, and increases the power consumed. The loss of light displeases the customers and discredits the service. If light is sold by meter, the increased power consumption dissatisfies the customers; if light is sold by contract, the additional power is a dead loss to the station. If increased light is needed, 20-cp lamps should be installed instead of raising the pressure. Their first cost is the same as 16-cp lamps; they take but little more current than 16-cp lamps operated at high voltage and give greater average light.

Increased pressure also decreases the commercial life of the lamp, and this decrease is at a far more rapid rate than the increase of pressure, as shown in the following table. This table shows the decrease in life of standard 3.1-watt lamps due to increase of normal voltage:

Per cent. of normal voltage.	Life factor.
100	1,000
101	.818
102	.681
103	.662
104	.452
105	.374
106	.310

From this table it is seen that 3 per cent. increase of voltage halves the life of a lamp, while 6 per cent. increase reduces the life by two-thirds.

Irregular pressure, therefore, necessarily results in the use of lamps in which the power consumption per candle is greater than a well regulated pressure would allow. The result is reduced capacity of station, and reduced station efficiency.

These remarks apply with special force to alternating current stations, since we have here two sources of possible irregularity in voltage—the generator and the transformer. Poor regulation is most apt to occur in the transformers and the utmost care should, therefore, be taken in their selection and use. The efficiency of the average lamp on alternating systems is nearly 4 watts per candle. With good regulation obtained by the intelligent use of modern transformers, the use of lamps of an efficiency of 3.1 watts per candle becomes practicable. It is thus possible to save 25 per cent. in power consumption at the lamps and increase the capacity of the station and transformers by the same amount.

In the past two years there has been a marked advance in the method of making transformer installations. The general adoption of higher voltage secondaries gives smaller loss in wires and permits the use of larger transformer units, thus greatly improving the regulation. On this account 50-volt lamps are gradually going out of use. The replacement of a number of small transformers by one large unit, and of old, inefficient transformers by modern types, has also been of immense advantage to stations. A large number of stations, however, still retain these old transformers, and load their circuits with large numbers of small units. Such stations necessarily suffer from loss of power, had regulation and a generally deteriorated lighting service. Simply as a return on the investment, it would pay all such stations to scrap their old transformers and replace them with large and modern units.

Proper care in the selection of transformers considers the quality and the size. Quality is the essential consideration and should have preference to first cost. No make of transformer should be permitted on a station's circuit that does not maintain its voltage ratio well within 3 per cent. from full load to no load. The simple rule regarding size is to use as large units as possible and thus reduce the number of units as far as the distribution of service permits. Every alternating station should aim to so improve regulation as to permit the satisfactory use of 3-watt lamps.

Good regulation is eminently important to preserve the average life and light of the lamps, to prevent the increase of power consumed by the lamps, and to permit the use of lamps of lower power consumption, so that both the efficiency and capacity of the station may be increased.

Constant voltage at the lamps can be maintained only by constant use of reliable portable instruments. No switchboard instrument should be relied on, without frequent checking by some reliable standard. Owing to the varying drop at different loads, constant voltage at the station is not what is wanted. Pressure readings should be taken at customers' lamps at numerous points, the readings being made at times of maximum, average and minimum load. Not less than five to ten readings should be made at each point visited, the voltmeter being left in circuit for four or five minutes and readings taken every fifteen seconds. The average of all the readings gives the average voltage of the circuits. Lamps should be ordered for this voltage, or if desired, the voltage of the circuits can be reduced or increased to suit the lamps in use. The practical points are to determine the average voltage at frequent period with a portable voltmeter

at various points of the circuit, and then to arrange the voltage of the lamps and circuits so that they agree.

The amount of light given by lamps of the same efficiency is the only proper measure of their relative value. The amount of light given, expressed in candle-hours, is the product of the average candle-power for a given period by the length of the period in hours.

Many of the best central station managers consider that a lamp has passed its *useful life* when it has lost 20 per cent. of its initial candle-power. In the case of a 16-cp lamp the limit would be 12.8 candle-power. The period of time a lamp burns until it loses 20 per cent. of its candle-power may therefore be accepted as its useful life. The product of this period in hours by the average candle-power gives the "candle-hours" of light for any given lamp.

The better a lamp maintains its candle-power under equal conditions of comparison the greater will be the period of "useful life" and therefore the greater will be the "candle-hours." This measure is, therefore, the only proper one with which to compare lamps and determine their quality.

The practical method of comparison is as follows: Lamps of similar candle-power and voltage are burned at the same initial efficiency of 3.1 watts per candle on circuits whose voltage is maintained exactly normal. At periods of 50, 75 or 100 hours the lamps are removed from the circuits and candle-power readings taken, the lamps being replaced in circuit at the end of each reading. Readings are thus continued until the candle-power drops to 80 per cent. of normal. The results obtained are then plotted in curves, and the areas under these curves give the "candle-hours" and the relative value of the different lamps.

In the following table is shown the variation in candle-power and efficiency of standard 3.1-watt lamps, due to variation of normal voltage:

Per cent. of normal voltage.	Per cent. of normal cp.	Efficiency in watts per candle.
90	53	4.68
91	57	4.46
92	61	4.26
93	65	4.1
94	69½	3.92
95	74	3.76
96	79	3.6
97	84	3.45
98	89	3.34
99	94½	3.22
100	100	3.1
101	106	2.99
102	112	2.9
103	118	2.8
104	124½	2.7
105	131½	2.62
106	138½	2.54

Example.—Lamps of 16 candle-power, 105 volts and 3.1 watts, if burned at 98 per cent. of normal voltage, or 103 volts, will give 89 per cent. of 16 candle-power, or 14¼ candle-power and the efficiency will be 3.34 watts per candle.

The importance and necessity of proper lamp renewals applies forcibly to all stations, regardless of the cost of power and whether lamp renewals are charged for or furnished free. The policy of free lamp renewals at the present low price of lamps is, however, preferable for both station and customer. Free lamp renewals give a station that full and complete control of their lighting service so requisite to perfect results.

Since, however, a large number of companies charge for renewals, we offer some suggestion as to the best method of inducing customers to renew their old lamps, for it is evident that some inducement is necessary.

Offering new lamps in exchange for dim lamps at a reduction in price is one good method. A customer, for example, would save by paying say half price for the renewal of a dim lamp, instead of waiting and paying full price when the lamp burns out.

Another method is to offer lamps for renewals at less than cost, say 15 cents each, and reserve the right to say when lamps shall be renewed. Such a plan works well, as no customer can justly complain when the company renews lamps at less than cost.

As profit on the lamps is certainly secondary in importance to the sale of current and the improvement in quality of light, either of the above plans should commend themselves to all central stations not furnishing free renewals.

Whatever method be adopted, the one chief principle of good economical lighting service should never be forgotten, viz.: that the average life of lamps should never exceed *600 hours.*

The following points should also be remembered:

That a constant pressure at the lamps must be maintained.

That the lamps are not to be used to the point of breakage—they should be renewed when they become dim.

That satisfaction to customers, and the success of electric lighting, is dependent upon good, full and clear light, which old, black and dim lamps cannot give.

That to furnish a good, full and clear light is as much a part of the lighting company's business as to supply current to light the lamps.

That a company should always endeavor to keep the average life of lamps within 600 hours.

That to renew dim lamps properly on the free renewal system, inspectors should examine the circuits regularly when the lamps are burning. If lamp renewals are charged to customers, induce them to exchange their dim lamps.

Rapid loss of candle-power is one defect in incandescent lamps, and we have shown that all lamps suffer a gradual loss of candle-power as they are used. A very rapid loss in candle-power is, however, a real fault, due to inexperienced manufacture, or use at excessive voltage. The pressure should be carefully tested with accurate portable instruments at the lamp sockets, and if found high, the pressure should be regulated to accord with the voltage of lamps, or lamps supplied to accord with the pressure.

Another defect in incandescent lamps is the blackening of bulbs, although this is more often a supposed defect than a real one. A lamp may lose in candle-power and show but little blackening, and on the other hand, the lamp may get quite black and lose little in candle-power. Thus a 50-volt lamp which has a more stable filament than the 110-volt lamp often shows considerable blackening with little loss of candle-power.

Blackening in good lamps results from either high pressure or excessive life. This is a supposed fault. The best of lamps, if burned too long, will always show a certain amount of blackening. The remedies are, of course, regulation of pressure and frequent renewals.

The above are the most important defects to be found in incandescent lamps.

The subject of illumination has been divided by Mr. E. L. Elliott, to whom we are indebted for many suggestions, into the following sub-divisions: Intensity or Brilliancy, Distribution, Diffusion, and Quality.

The average brilliancy of illumination required will depend on the use to which the light is put. "A dim light that would be very satisfactory for a church would be wholly inadequate for a library and equally unsuitable for a ball room.

The illumination given by one candle at a distance of 1 foot is called the "candle-foot," and is taken as a unit of intensity. In general, intensity of illumination should nowhere be less than 1 candle-foot, and the demand for light at the present time quite frequently raises the brilliancy to double this amount. As the intensity of light varies inversely with the square of the distance, a 16-cp lamp gives a candle-foot of light at a distance of 4 feet. A candle-foot of light is a good intensity for reading purposes.

Assuming the 16-cp lamp as the standard, it is generally found that two 16-cp lamps per 100 square feet of floor space give good ilumination, three very bright, and four brilliant. These general figures will be modified by the height of ceiling, color of walls and ceiling and other local conditions. The lighting effect is reduced, of course, by an increased height of ceiling. A room with dark walls requires nearly three times as many lights for the same illumination as a room with walls painted white. With the amount of intense light available in arc and incandescent lighting, there is danger of exceeding "the limits of effective illumination and producing a glaring intensity," which should be avoided as carefully as too little intensity of illumination.

Distribution considers the arrangement of the various sources of light and the determination of their candle-power. The object should be to "secure a uniform brilliancy on a certain plane, or within a given space. A room uniformily lighted, even though comparatively dim, gives an effect of much better illumination than where there is great brilliancy at some points and comparative darkness at others. The darker parts, even though actually light enough, appear dark by contrast, while the lighter parts are daz-

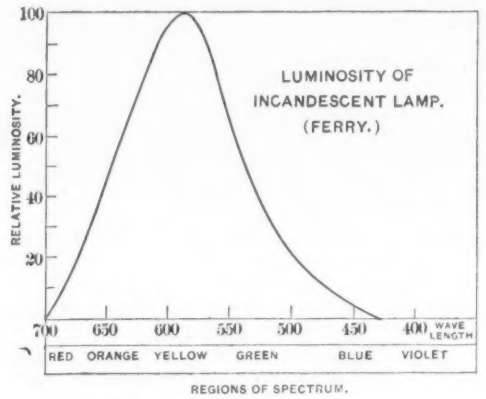
zling. For this reason naked lights of any kind are to be avoided, since they must appear as dazzling points, in contrast with the general illumination.

The arrangement of the lamps is dependent very largely upon existing conditions. In factories and shops, lamps should be placed over each machine or bench, so as to give the necessary light for each workman. ' In the lighting of halls, public buildings and large rooms, excellent effects are obtained by dividing the ceilings into squares and placing a lamp in the centre of each square. The size of square depends on the height of ceiling and the intensity of illumination desired. Another excellent method consists in placing the lamps in a border along the walls near the ceiling.

For the illumination of show windows and display effects, care must be taken to illuminate by reflected light. The lamps should be so placed as to throw their rays upon the display without casting any direct rays on the observer.

The relative value of high candle-power lamps compared with an equivalent number of 16-cp lamps is worthy of notice. Large lamps can be efficiently used for lighting large areas, but in general a given area will be much less effectively lighted by high candle-power lamps than by an equivalent number of 16-cp lamps. For example, 16-cp lamps distributed over a large area will not give as good general illumination as sixty-four 16-cp lamps distributed over the same area. High candle-power lamps are chiefly useful when a brilliant light is needed at one point, or where space is limited and an increase in illuminating effect is desired.

"Diffusion refers to the number of rays that cross each point. The amount of diffusion is shown by the character of the shadow. Daylight on a cloudy day may be considered perfectly diffused; it produces no shadows whatever. The light from the electric arc is least diffused, since it emanates from a very small surface; the shadows cast by it have almost perfectly sharp outlines. It is



CURVE OF LUMINOSITIES.

largely due to its high state of diffusion that daylight, though vastly more intense than any artificial illumination, is the easiest of all lights on the eyes. It is a common and serious mistake, in case of weak or overstrained eyes to reduce the intensity of the light, instead of increasing the diffusion."

"Aside from difference in intensity, light produces many different effects upon the optic nerves and their centres in the brain. These different impressions we ascribe to difference in the quality of the light. Thus, 'hard light,' 'cold light,' mellow light,' 'ambient light,' etc., designate various qualities. The most obvious differences in quality are plainly those called color. But color is by no means the element of quality. The proportion of invisible rays and the state of diffusion are highly important factors, but on account of not being directly visible, they have been generally overlooked, and are but imperfectly understood."

As showing the quality of the incandescent light, we present here a curve showing the relative luminosity of an incandescent lamp at different regions of the visible spectrum.

On this subject Mr. E. L. Nichols states the following:

"The most important wave lengths, so far as light-giving power is concerned, are those which form the yellow of the spectrum and the relative luminosity falls off rapidly both toward the red and the violet. The longer waves have, however, much more influence upon the candle-power than the more refrangible rays.

"Luminosity is the factor which we must take into account in seeking a complete expression for the efficiency of any source of illumination, and the method to be pursued in the determination of luminosity must depend upon the use to which the light is applied. If we estimate light by its power of bringing out the colors of natural objects, the value which we place upon the blue and violet rays must be very different from that which would be ascribed to them if we consider merely their power of illumination as applied to black and white. In a picture gallery, for instance, or upon the stage, the value of an illuminant increases with the temperature of the incandescent material out of all proportion to the candle-power, whereas candle-power affords an excellent measure of the light to be used in a reading room."

The relative value of the arc and incandescent systems of lighting is frequently difficult to determine. Incandescent lamps have the advantage that they can be distributed so as to avoid the shadows necessarily cast by one single source of light. Arc lamps used indoors with ground or opal globes cutting off half the light, have an efficiency not greater than two or three times that of an incandescent lamp. Nine 50-watt, 16-cp lamps consume the same power as one full 450-watt arc lamp. It has been found that unless an area is so large as to require 200 to 300 incandescent lights distributed over it, arc lamps requiring equal total power will not light the area with as uniform brilliancy.

An objection frequently urged against the incandescent lamp is that it is harmful to the eyes and ruins the sight. This is true only in so far as the lamp may be improperly used. Any form of light as frequently misused would produce the same harmful results. Few people think of attempting to read by an unshaded oil lamp, and yet many will sit in the glare of a clear glass incandescent lamp. Incandescent lamps are more generally complained of because, unlike oil or gas, they can be used in any position. Bookkeepers and clerks are often seen with an incandescent lamp at the end of a drop hanging directly in front of their eyes—an impossible position of the light from gas or oil.

The first hygienic consideration in artificial lighting is to avoid the use of a single bright light in a poorly illuminated room. In working under such a light, the eye is adapted to the surrounding darkness, and yet there is one spot in the middle of the eye that is kept constantly fixed on the very bright light. The brilliancy of the single light acting on the eye adjusted to darkness works harm. There should be a general illumination of the room in addition to any necessary local light. If sufficient general illumination is provided, the eye is adjusted to the light, and the local light can be safely used. The ideal arrangement provides general illumination so strong that a pencil placed on the page of a book casts two shadows of nearly equal intensity—one coming from the general light and the other from the local light.

George R. Blodgett—In Memoriam.

I feel that I cannot let the occasion pass without paying some slight and inadequate tribute to the memory of Mr. George R. Blodgett whose sad death all who knew him and to whom he was endeared must deeply mourn and depore. Association for years with him and his work in the Patent Department of the Thomson-Houston and General Electric Companies, taught me to esteem him most warmly as a man and as a friend, and to value very highly his exceptional abilities. Gifted as he was with a clear comprehension of affairs of business and commercial methods, he also possessed the qualities valuable in a legal counsellor, combined with such a clear and precise technical insight as is very rarely to be found in the same person. I know of no one else more fully acquainted with electrical patent matters, generally speaking, and particularly with the patents of the companies whose patent interests were largely in his care.

He was broad-minded, of a liberal, hopeful nature, his work was always carefully and thoroughly done, and his industry was unceasing. He enjoyed the respect and esteem of everyone who knew him.

Had he lived, his fine qualities of mind must certainly have brought rich honors in later years. My own keen sense of personal loss is not to be expressed in words. Many others, as his friends, will share my feeling. Still others, alas, bound to him by much closer ties, will far more deeply mourn. ELIHU THOMSON.

Meeting of the Northwestern Electrical Association.

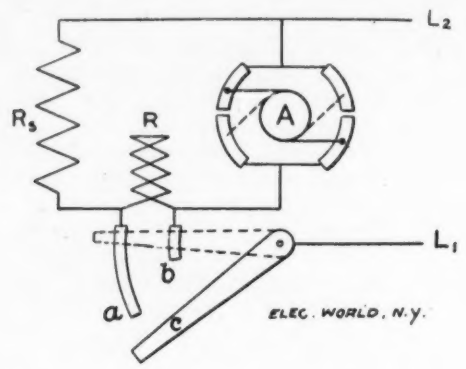
The sixth annual meeting of the Northwestern Electrical Association will be held at Milwaukee, Wis., commencing January 19, 1898.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Starting Resistance for Motors. MENGES. *Elek. Zeit*, Dec. 2.—A short article describing in detail his method, the main features of which were mentioned in the *Digest* some years ago. The object is to cut out rapidly and without sparking, resistances of high self-induction, such as the magnet windings of shunt motors or generators; he accomplishes it by never breaking the circuit composed of the magnet windings, the starting resistance and the armature; to reverse the motor the armature connections alone are reversed, without breaking the circuit. The arrangement is shown diagrammatically in the accompanying figure, in which the coil to the left represents the magnets, *A* the armature and *R* the starting resist-



ance; *c* is the switch; when this is being closed the resistance is in series with the armature, but is short circuited after starting; on opening the self-induction current of the coils discharges through the starting resistance and the armature; the reversing of the motor had better be done at the brush holder; he has used this method with success for a number of years. Additional illustrations show how the switch is arranged for step by step starting resistance; in this the switch merely short circuits successive portions of resistance *R*. For the special case in which a dynamo is to be used as a motor with accumulators, as for starting gas engines, for instance, a modification is suggested and illustrated with a diagram. One of the great advantages of this method is that motors may be switched off very rapidly, thus losing no time, which is important in many cases when motors are used to drive tools.

Phase Transformer. LOMBARDI. *Elek. Zeit.*, Dec. 2.—The conclusion of his long article (see *Digest*, Dec. 11); the results of a test are given in tables. He concludes that the results show that the system is commercially applicable, especially where a single-phase non-synchronous motor is in use and when it is possible by means of a second stationary winding to take from it a current of a suitable phase, with the aid of which very small multiphase motors may be run, larger ones started or the original motor itself started.

Regulation of the Exciting Current. GIBSON. Lond. *Elec. Rev.*, Dec. 3.—A short article on the regulation of the field current in a three-phase generator working singly with a widely varying motor load; he suggests an apparatus in which an alternating current magnet operates a number of wires of different lengths, dipping into mercury, and thus regulating the exciting current.

Tunnel Armatures. MENGES. Lond. *Elec.*, Dec. 3.—A continuation of the recent discussion; he replies to Baily.

Determining the E. M. F. of Alternators. KNUDSON. *West. Elec.*, Dec. 11.—The first part of an article showing how to calculate the virtual E. M. F. of alternators, that is, the square root of the mean square; a portion of it is of a somewhat elementary character.

LIGHTS AND LIGHTING.

Long Lived Carbon for Arc Lamps.—Elek. Anz., Nov. 21.—A note taken from a newspaper stating that Strauss made an important invention which has been sold to an English syndicate for over half a million dollars; in his carbons there is said to be a saving of current of 26.5 per cent., and that a very good light is obtained for 360 hours; the light is said to be different from that of the present arc light, having a rich color and much superior to the present; he expects to increase the life to 1000 hours; a factory is said to be in progress of construction in Germany. Editorially it is stated that these statements cannot be accepted until they are substantiated by better authority. The Lond. *Elec. Eng.*, Dec. 3, notices briefly a paragraph on this same subject in that journal, in which it is stated that, according to a Russian patent, carbons are made of the purest possible carbon and carbide of silicon pulverized very finely and united by a combining material, such as tar; 90 per cent. of carbon and 10 per cent. of the carbide is found to be a good proportion; the carbide does not contain volatile ingredients and has the highest power of resisting oxidation of any known bodies. It develops a light of great intensity; it does not conduct, and can therefore be used only in conjunction with carbon.

Electric Lighting in Paris. BOS. *L'Eclairage Elec.*, Nov. 27.—A long abstract of his recent official report; his conclusions are given regarding the present situation of public and private lighting in Paris, and a comparison of the different prices paid.

Lighthouses and Light Vessels.—Elec. Rev., Dec. 3.—The beginning of a reprint of the fifth and final report of the Royal Commission concerning the requirements along the English coast.

POWER.

Electrically Driven Tools.—Lond. *Engineering*, Dec. 3.—In this installment of a series of articles on Vickers' Works at Sheffield, a very well-illustrated description of the electrical driving gear for a 40-inch lathe and a double boring machine is given; the lathe is driven by cone pulleys and the boring machine by three pairs of spur wheels.

Steam Power in Prussia.—Elek. Zeit., Dec. 2.—A reprint of some tables giving the number of steam engines and the power used entirely and in part for the generation of electrical energy in Prussia; the total number of engines is 2837 and the total power is 191,935; during the last six years the increase has been threefold in the number of engines and fourfold in the power; 93.1 per cent. of all the engines are used for lighting purposes.

Mining Plant in Pennsylvania. GREELEY. Lond. *Elec. Rev.*, Dec. 3.—An abstract of a recent paper describing a central-station mining plant in Pennsylvania, but the name of the place is not given.

Protection Against Lightning.—Jour. of El'ty, Nov.—Reprints of a series of papers read before the Pacific Coast Electric Transmission Association. THEBERATH, in the first paper on "Lightning on Transmission Lines," discusses briefly the question of what lightning is and what some of its properties are; he gives the well known requirements of a good lightning arrester, and after stating that arresters with moving parts have been entirely abandoned by nearly all manufacturers, he describes and discusses the arresters of the non-arcing metal type, as these are giving the best results at the present day; one form which has been designed recently consists of a series of concentric cylinders with flaring tops, thus combining the non-arcing principle with the natural air blast to rupture the arc; he recommends the use of self-induction coils; on alternating currents the objection to the impedance thus introduced has been removed by using two coils connected in opposition to each other on the same leg of the circuit, this being found to practically eliminate the self-induction as far as dynamo currents are concerned, but offering a high impedance to lightning discharge. Arresters should be installed at each end of a long line and at the terminal points of all its branches; a barbed wire, well grounded, and strung over the tops of the poles, will form some protection but should not be depended upon; lightning discharge is of a somewhat selective character, for which reason the lightning arresters should be arranged in banks so as to offer several paths. In a paper on lightning at Sacramento, HUTTON describes the experiences in that installation. According to recent estimates it is claimed that the loss to companies due to lightning discharges are between $250,000 and $350,000 annually; he shows that a single set of arresters at both ends of the line, no matter how perfectly constructed, do not necessarily protect the apparatus; there should always be enough arresters distributed along the line; in the case of transmission lines the

conditions are somewhat different and these are protected at the ends only; in this plant there has been very little trouble since the arresters were introduced. In a paper on lightning in Nevada County, DE SABLA describes the experiences of his company, which has had comparatively little trouble. In another on lightning and long transmission by SUTCLIFEE he gives his experiences briefly; along his lines the discharges were infrequent and seldom violent, but in every case they were conducted safely to ground.

Transmission at 30,000 Volts.—Jour. of El'ty, Nov.—A short editorial describing a recent experimental run lasting three days at a potential of 30,000 volts under the most trying climatic conditions. The plant is the one at Salt Lake City, that runs normally at 15,000 volts; the transformers were connected so as to give 30,000 volts, and the length of line was 73 miles, over which 1000 horse-power was delivered; the maximum loss, including that due to the transformers, was 9.9 per cent. as measured by watt meters at both ends of the line; it is claimed that there was no loss of voltage, as the capacity of the line was "sufficient to compensate for the potential drop"; not the slightest difficulty of any kind developed during the entire seventy-two hours of the test; there was the worst possible weather, including severe lightning, during which the arresters discharged repeatedly, but without causing a flickering in the light circuits.

Paderno.—Elec. Eng., Dec. 9.—An illustrated description of this water power plant in Italy, which was started in 1895, and is now nearly completed. The total available power is 17,280, and the first cost per horse-power will be about $31; the capacity of the present plant will be 2180 horse-power; there will be seven three-phase alternators of 2180 horse-power "each," direct connected to turbines; the E. M. F. will be 13,500, with a frequency of 42 at 180 revolutions; part of the current will be transmitted to Milan, a distance of 20 miles, by means of eighteen conductors; the current will be used for electric railways and lighting.

TRACTION.

Accumulator Traction. Lond. *Elec.*, *Elec. Eng.* and *Elec. Rev*, Dec. 3; in abstract in the latter journal.—A reprint of the resumed discussion of Epstein's recent paper (see *Digest* Dec. 11). Manby described the Marchmer accumulator which is now used in Dresden; the cars have a single motor; the complete weight of the battery was about 77 pounds per kw hour, but a still lighter form is being made; they are charged at 60 amperes at the rate of $1.75 for a full charge, which amounts to 1.68 cents per mile; it is charged while on the car, and only once a day; its efficiency has not been impaired during the six months used; the motor car weighs about 12 tons, including battery and passengers, and it hauls another weighing 5.5 tons loaded; they traveled 130 miles without recharging; it developed 69 kw hours, which makes 39 watt hours per ton mile, while Epstein assumed 80. Ayrton called attention to the unreliability of data as usually given; a report stated that the Lamina under normal conditions gave 14 watt hours per pound gross weight, which is nearly twice as much as he had ever found with any other accumulators, the best results which he had obtained being 8 watt hours per pound gross weight, or 9 when discharged at half the test rate. He then spoke of the resistance to traction, referring to some tests he had made on bicycles in which he found that to drag a bicycle in good condition over a concrete road required about 30 pounds per ton at a speed of 5 5 miles per hour; on a good macadamized road 43 pounds per ton at 12 miles an hour; Epstein's estimate of 60 pounds per ton was therefore not excessive, being rather under than over the truth; at 9 watt hours per pound gross weight, the weight proposed by Epstein ought to be doubled for a 52 passenger car, in fact, 5 tons of accumulators were necessary; according to Manville, an electric cab carrying only three people required 3 horse-power from the battery on a smooth wood pavement, and 5 horse-power on macadamized roads; he suggests different groups of batteries instead of using double motors. Parker showed why the Birmingham experiment failed; he claims that given a free hand it would have been successful, and that he would to-day guarantee to make a line pay. Wilson spoke of the relative weight and output of cells, giving the results of some recent experiments showing 7.43 watt hours per pound gross weight, making a total weight of 1490 pounds, as against Epstein's estimate of 1000 for doing certain work; the chloride battery showed a somewhat greater weight. Hall spoke of the size of the cell, and favored constant potential charging at which the efficiency would be higher; experiments made some years ago with two similar plates, one twice as thick as the other, showed that they both had the same capacity; the ideal accumulator should have such a thickness of active material that nearly the whole of it undergoes change at every charge and discharge; the output corresponds to about one-third of that represented by the whole of the active material. Carter favored the series paralleling of the cells rather than the motors.

Flywheels for Traction Engines. RAWORTH. Lond. *Elec.*, Dec. 3.—A long communication explaining more in detail his recent statement against the use of flywheels. He claims that the variations in load do not and cannot produce any strains in the engine in excess of those caused by the steam, and therefore all the talk about shocks and strains is inaccurate and misleading; the stored flywheel power simply intensifies the strains in the dynamo but not in the engine; American practice defeated its own object; changing the field excitation will enable the flywheel to give out some portion of its stored energy without permitting the voltage to fall. His communication is discussed editorially in the same issue.

Jungfrau Railway.—Lond. *Elec.*, Dec. 3.—A note stating that a portion of the generating plant representing 1200 horse-power will be running in a few days for supplying power for boring the tunnels; the permanent way to the Eiger glacier is also practically finished, and trains will be running on this part before the end of June.

Motor Bicycle.—Lond. *Elec.*, Dec. 3.—A brief reference to a motor tandem bicycle designed for pacing; it contains a 1.25-hp motor and sixteen accumulator cells; a speed of 30 to 40 miles an hour can be obtained.

Rail Bonding. HARRINGTON. *Elec. Eng.*, Dec. 16.—A reprint of a short Franklin Institute paper, in which he discusses briefly some of the practical features of rail bonds and gives a table of measurements made of the resistance of thirteen different forms of bonds, comparing the same with a solid rail and a simple joint without a bond; the names of the bonds are given, and their relative merits pointed out; the plastic cork bond was found to be the best. (In the discussion of that paper, which is not reprinted, the author admitted that the resistance measurements were made with only one sample of each of the bonds, that is, the results do not represent the average of a number of tests of each bond.)

Engines for Electric Traction. EMERY. *St. Ry. Jour.*, Dec.—A reply to a letter published in the Lond. *Elec. Rev.* (see *Digest*, Nov. 13), criticising the article which appeared in the October issue of this journal (see *Digest*, Oct. 23). The principal statement to which exception was taken was that direct-connected engines for railway work need not be exceptionally heavy to withstand the varying load which takes place in electric traction, because "every automatic expansion engine takes the full boiler pressure at every stroke, whether the load be light or heavy, and in every stroke the total pressure commences at maximum and falls to minimum; consequently in the normal working of such an engine under sudden load the changes in the rate at which power is being generated vary from maximum to minimum from two to six times per second." Emery replies that when a load is thrown suddenly on the engine in railway work the fly wheel tends to twist the shaft, and the moving parts are brought up with a shock instead of being changed smoothly by a crank motion, and in releasing the load suddenly the elasticity of the parts and their weight also produces shocks; the side strains are also different with heavy loads and light ones.

Railway Motors. HANCHETT. *St. Ry. Jour.*, Dec.—This is the fourth of a series of articles, and is a comparative description of the frames and internal construction of the principal electric motors now in use.

Electric Equipment of an Elevated Road.—West. Elec., Dec. 11.—An illustrated description of parts of the work in changing the Alley elevated road from a steam to an electric road.

Instruments on Power-Station Switchboards. MOFFATT. *St. Ry. Jour.*—A short description of the different types of switches, cut-outs, rheostats and lightning arresters in use.

Controller. SHORT. *Elec. Rev.*, Dec. 15.—An illustrated description of the new controller of the Walker Company.

Train Acceleration.—Eng. News, Dec. 9.—A brief discussion by Cooper and Potter of formulas for the tractive effort in train acceleration tests. The former claims to point out an error, and the latter replies, including examples.

Conduit Railway Construction in New York.—St. Ry. Jour., Dec.—An extended illustrated description of the electric conduit construction now being installed in New York by the Metropolitan Street Railway Company, together with working plans of the straight track construction, curves, cross-overs, switches and plows. The reasons are also given which induced the company to adopt their present system.

Launch.—Elec. Eng., Dec. 16.—An illustrated description of the elaborately finished electric launch which is being constructed in New York for the Czar of Russia. The length is 37 feet, the extreme width a little over 7 feet, and the displacement without passengers 5.2 tons; it is provided with storage batteries, and is to have a speed of 8 miles an hour for three hours or 7 miles for six hours.

Harvard Power Station, Boston.—*St. Ry. Jour.*, Dec.—A short description of a new station of the West End Street Railway Company. The station contains three 1200-kw horizontal cross-compound direct-connected units.

Electric Railway in Alexandria, Egypt.—St. Ry. Jour., Dec.—A short translation of the article noticed in the *Digest* Dec. 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Three-Wire Practice in England and America. LOMAS. Lond. *Elec. Rev.*, Dec. 3.—A brief comparison. England has no three-wire stations that at all compare in size with those in America, and many differences of detail, therefore, arise; for the same output the Americans build two dynamos, while in England the dynamo gives the full voltage of the outers, and there are then one or two balancing machines; the grounding of the neutral is quite out of the question when bare copper mains are used, as in some places in England.

Controlling the Voltage.—Lond. *Elec. Eng.*, Dec. 3.—Several replies to

the question of what the best way is of controlling, from a central station, the pressure of the supply when a number of feeders of various lengths are in use. Fennell enumerates the methods, stating that all are good, and that the best way will vary with the circumstances, no one being the best for every case. Locke distinguishes between alternating and direct currents, and enumerates the methods; Pilling gives, as the most efficient feeder regulator, an adjustable transformer in the circuit of each feeder.

Distribution of Electrical Energy. Boot. Lond. *Elec. Rev.*, Dec. 3.—A reply to the recent paper of Wordingham; he defends the alternating-current system.

Manchester.—Lond. *Elec.*, Dec. 3.—Some notes and illustrations showing the present stage of development of the system used in that city; it is published in connection with Wordingham's recent paper, a reprint of which is begun in that journal.

WIRES, WIRING AND CONDUITS.

Rules and Regulations.—Elek. Zeit., Dec. 2.—An editorial on the success of the rules which were prepared in Germany two years ago; their worth is now indicated by the fact that after two years of practical experience they have been found to be very satisfactory and have been generally adopted; of eighty-three works who replied to communications 98 per cent. have expressed themselves satisfied with these rules (no replies were received from 245 of the works).

Losses Between the Bus Bar and the Meter.—Lond. *Elec. Eng.*, Dec. 3.—Answers to the question of what are the various losses with the various systems of supply and how they can be reduced; also how far it is wrong to consider the maximum loss as an indication of the disadvantages of any system; several columns of answers are published.

Insulators for Transmission Lines. Martin. *Jour. of El'ty*, Nov.—A reprint of a short paper describing a process of making porcelain insulators which has given the best results; a porcelain insulator should be vitreous throughout its entire body and it should have the same coefficient of expansion throughout.

Safe Current Capacity for Electrical Conductors. Sewall. *Elec. Eng.*, Dec. 9 and 16.—A reprint of a recent paper which was noticed in the *Digest*, Dec. 11.—In that notice a typographical error occurred, the author's name being Sewall instead of West, and the first reference should have been *West. Elec.*, Nov. 27.

Development of the Circuit Breaker. Scott. *Elec. Rev.*, Dec. 15.—A reprint from a book published by a maker of circuit breakers; he describes in general the advantages of these over fuses.

ELECTRO-PHYSICS AND MAGNETISM.

Model of an Electric Circuit. Garbasso. Lond. *Elec.*, Dec. 3; abstracted briefly, with the illustration, from the *Nuovo Cimento*, Oct.—The model consists of a long, thin shaft driven by a pulley, which represents the E. M. F.; the resistance is represented by radial veins and the current strength by the angular velocity; inductance is represented by a cross-piece, to which movable weights are attached, whose position can be suddenly altered; capacity is represented by a twisted wire secured axially to the end of the shaft; a second system connected with the first by a set of bevel wheels represents the secondary circuit.

Physiological Effects of X-Rays. Balthazard. *Rev. Gn. dées Sciences*, Nov. 30.—A short article, in which he endeavors to prove that the physiological action of these rays is much less important than that of the electric radiations which accompany them; in all experiments with X-rays the electric radiations should be excluded by a screen of aluminum.

Motion of the Ether. Lorentz. Lond. *Elec.*, Dec. 3; abstracted briefly from the *Verslag. Akad. Amsterdam*, Nov. 10.—He criticises the conclusions drawn from experiments which Michelson made some time ago.

Potential of the Double Layer. Liapounoff. *L'Eclairage Elec.*, Nov. 27.—A reprint of an Academy paper of a theoretical nature.

Interpretation of the Zeemann Phenomenon. Cornu. *L'Elec.*, Dec. 4.—An abstract of a Physical Society paper on observations and the kinematic interpretation of this phenomenon.

Interpretation of the Faraday and the Zeemann Phenomena. Becquerel. *L'Eclairage Elec.*, Nov. 27.—A reprint of an Academy paper giving an interpretation of these two phenomena.

Photographs of the Zeemann Effects. Zeemann. Lond. *Elec.*, Dec. 3; abstracted briefly from the *Verslag. Akad. Amsterdam*, Nov. 10.—He succeeded in producing photographs of the effect which were suitable for measurement, with an exposure of fifteen minutes.

Theory of the Magnetic Influence on Spectra; Radiation from Moving Ions. Larmor. *Phil. Mag.*, Dec.—A theoretical analysis of a general character in connection with Zeemann phenomenon which he believes may help to throw light on the nature of electric vibrations in the molecule.

External Field of Magnetized Rings. Mordey. *Phil. Mag.*, Dec.—A short article offering an explanation of the recent statement of du Bois, namely, that a ring magnet experiences a side thrust when in the external field, whose lines of force are in the same plane as the ring, and it exerts a thrust in the opposite direction on the supporter of the external field. Magnetically, a helix traversed by a current acts as a series of rings, but in addition it has a small magnetizing effect at right angles to that of the rings, due to the advance of the conductor from end to end of the helix; this latter effect is that of a simple loop or ring of the conductor carrying the current; the magnetizing effects due to this cause can be made zero if the helix is wound in two layers, one forward and the other backward.

Self-Regulating X-Ray Tube.—Elec. Eng., Dec. 16.—An illustrated description of Rice's modification. A well-known system of regulation is in use, in which there is a spark gap shunting the tube, in series with which gap there is a small tube containing the usual volatile salt; the objection to this is that the spark is annoying, that the regulation produces a flickering, and that the sparks sometimes partially short circuit the tube. In the present arrangement the shunt spark gap is replaced by a long tube containing water, the resistance of which is very high; a shunt current passes through this continuously; otherwise the arrangement is similar to the well-known one. He found that a tube three thirty-seconds of an inch inside diameter and about two feet long, filled with water, affords the proper amount of resistance.

X-Ray Tubes. Rollins. *Elec. Rev.*, Dec. 15.—A short description of his tube, in which there is a movable anti-cathode secured to an iron ring which may be moved in the tube by means of a magnet on the outside so as to put it into the best possible position; the tube cannot be transported. In two other short notes by the same author he considers it probable that one cause of the rise in the vacuum in X-ray tubes is that particles of the platinum leave the anode and carry the molecules of the gas against the glass, where they remain; he also believes that the angle of the lines of force with the surface of the cathode depends on the degree of vacuum in the tube.

Switch for X-Ray Work. Kolle. *Elec. Eng.*, Dec. 9.—An illustrated description of a double switch by means of which the motor circuit is closed first and that of the primary coil later, the circuits being opened in the reverse order.

Mutual Influence of Cathode Rays. Bernstein. *Elec. Eng.*, Dec. 9.—A reprint, without acknowledgment, of the abstract noticed in the *Digest*, Dec. 4.

Practical Application of the Coherer. Brown. *Elec. Eng.*, Dec. 9.—A reprint, without acknowledgment, of the article abstracted in the *Digest*, Dec. 4.

Magnetic Tests of Open Hearth Cast Steel.—West. Elec., Dec. 11.—Curves and data giving the results of a series of experiments by Stine, who used the Hopkinson divided bar permeameter; the permeability and hysteresis curves are given.

ELECTRO-CHEMISTRY AND BATTERIES.

Polarization Capacity of Membranes. Grimaldi and Platania. Lond. *Elec.*, Dec. 3; abstracted briefly from the *Nuovo Cimento*, Oct.—They investigated the polarization of a voltameter containing a thin metallic membrane which was charged for a very short and precisely determined interval; the experiments brought out the important influence of the duration of the charge on the polarization capacity; they show that the charge traverses the whole thickness of the gold film in a very short time.

Electrolytic Dissociation of Alcohol.—Lond. *Elec. Eng.*, Dec. 3.—A brief notice of a paper abstracted in the Journal of the Chemical Society. He dissociates methylic alcohol and water dissolved in it.

Cadmium Accumulator.—Lond. *Engineering*, Dec. 3.—A brief description of the Werner accumulator for which great lightness is claimed. A cell weighing 8.2 pounds gave 33.3 ampere hours with an initial E. M. F. of 2.4 volts and a final one of 1.9; he claims to have "replaced the electrolysis of water by electrolysis of sulphates"; he uses different alloys of zinc and cadmium; the negative plates are very thin, light sheets of iron covered with lead; the electrolyte consists of a mixture of sulphate of cadmium, magnesium and zinc; during the charge a deposit of a very strong and hard alloy of the above metals is formed; the total weight of a 35-ampere hour cell is "in the charged state" (*sic*) 710 grams against 1500 grams for existing accumulators, to which the weight of the usual casing must be added; the plate forming the positive pole it appears is covered with peroxide of lead. The capacity of his battery is given as forty ampere hours per kilogramme of plate; a battery for "autocars" will weigh with the motors about 500 pounds per horse-power, and will have energy enough for ten hours. No further information is given.

Carbon Battery. Picard. *L'Eclairage Elec.*, Nov. 27.—A short description from his recent British patent. He claims to have obtained a current by placing a plate of carbon in an electrolyte formed of litharge maintained in fusion in a copper crucible which latter forms one of the poles; the current passes from the copper through the external circuit to the carbon. When the circuit is closed metallic lead is deposited on the copper; this is regenerated by a jet of air which oxidizes the lead again. In order to diminish the large losses of energy due in part to the local action and the production of heat necessary for fusing the litharge, he mixes the latter with caustic soda, forming an alkaline plumbate, or with soda and silica, which gives the double alkaline silicates; using one of these for the electrolyte has the advantage of diminishing the expense due to maintaining

the heat owing to the greater fusibility, while the reactions of the litharge remain the same.

Gas-Carbon Electric Generator. SHORT. *Elec. Eng.*, Dec. 9.—An illustrated description, taken from his recent patent; the apparatus is for generating an electric current direct from coal and air. The coal is placed in a sort of gas retort, where it is baked, evolving gases which are collected and purified in the usual way; the remaining carbon or coke then forms one of the electrodes, which is subjected to the "electro-chemical action of an electrolyte capable of receiving oxygen and of transferring the same to the carbon to effect an oxidation thereof" under the influence of heat, the electrolyte being maintained in a molten condition; the carbon holder forms the positive element of the cell, but the negative pole; when the carbon is in a heated condition "the nascent oxygen of the electrolyte, or resulting from the electro-chemical action of the electrolyte, will attack the carbon more vigorously and freely, and hence result in a more efficient electric generation"; iron was found to be a suitable material for the carbon holder; it is in the shape of an iron tube dipping into the electrolyte, and having a perforated bottom; the hot coke rests in the perforated end which is in the electrolyte; the oxygen is supplied to the electrolyte in the form of air, which is pumped through it; "through electro-chemical action the oxygen is transferred through the electrolyte to the coke contained in the holder," where it attacks and oxidizes the coke, the product passing off as gas; "the result of the oxidation is the production of a current of electricity"; for the negative element he uses an oxidized or oxidizable material, such, for instance, as lead; the products of the combustion of the furnace which heats the coal retort are passed underneath the cell containing the electrolyte, thereby maintaining it at the proper temperature.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Secular Softening of Hard Steel, with Remarks on Electrical Standards. BARUS. *Phil. Mag.*, Dec.—A short article on the changes in steel, in the course of time, with a general reference to other metals; steel was chosen to experiment with, as its electrical resistance may by tempering from soft to hard be made to increase more than threefold, and the secular variations may therefore be more easily observed; comparisons were made covering a period of seventeen years, during which a change of about 15 per cent. was observed, the comparison being made with the same standards. A table shows the change of specific resistance of glass-hard steel with the temperature and the time of tempering, the steel being exposed to the temperatures named during a different number of minutes; the results are also given graphically, showing that the changes appear to follow a single law; the features to be noticed are the occurrence of a single and definite degree of soft temper for each temperature; this limit of softness is approached more rapidly in proportion as the temperature to which the rod is exposed is higher; after being tempered to the limit of softness for any temperature, say the boiling point of water, the steel is then molecularly stable at a lower temperature, and this in a more marked degree as the latter temperature falls below that at which the rod is tempered; he made use of this in making permanent magnets. Another table gives the softening effect of the atmospheric temperature acting through prolonged time; he shows that for a period of 180 months the same degree of hardness was produced as at 66° acting for a period of 180 minutes; one can infer with certainty that at 100° for a period of minutes a much greater softening will be produced than by atmospheric temperature acting for a like period of months; it may therefore be estimated that the secular change of resistances of the untempered standard for any period of months is very much less than the changes of the tempered wire for a like period of minutes; two hours of annealing at 100° would thus furnish the superior limit of change of the resistance standard within ten years; this tempering should be applied after coiling. He concludes with a few words on the causes of the changes.

Failure of German Silver and Platinoid Wires. APPLEYARD. Lond. *Elec. Rev.* and *Elec. Eng.*, Dec. 3.—An abstract of a Physical Society paper. There are two kinds of mechanical defects, one due to the constitution and metallurgy of the alloy and the other caused by the subsequent treatment and environment; in periods of time, from six weeks to several years after manufacture, the wires on some bobbins became brittle and broke even in the interior of the coil, while other coils remained in good condition; metallurgical differences thus exist between different samples of the same wire; the brittleness of German silver and platinoid wire is a subsequent phenomena or secondary brittleness. Paraffin is of no use whatever to protect coils against moisture, shellac varnish being greatly preferred. In the discussion Ayrton stated that some pure platinoid wires immersed in running water broke in short pieces; heating the wire to a dull red heat by an electric current corrected any acquired faults; the resistance temperature curve does not return upon itself but forms a loop; some manganin coils have behaved well during the past five years. Watson stated that according to the Reichsanstalt all alloys containing zinc were liable to erratic changes of resistance even when the zinc is only in the solder; silver solder should be used for manganin wires; absolute alcohol and shellac varnish should be used to protect coils, but they should afterward be heated; heating a German silver or platinoid wire in water produces brittleness.

Cadmium Cell. COHEN. Lond. *Elec.*, Dec. 3.—Abstracted briefly from *Verslag. Akad. Amsterdam*, Nov. 10.—He states that the E. M. F. of the Weston or cadmium cell is subject to certain irregularities at temperatures below 15° C; he found these to be due to a change undergone by the cadmium sulphate crystals near that temperature; the solubility line of cadmium sulphate shows a break at 13°; with an unsaturated solution a decided variation of E. M. F. occurs below 13°; all this shows that some change takes place at that temperature; to restore the original E. M. F. the cell must be heated above 15° for about an hour and a half.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Cables of the World.—Jour. Telegraphique, Nov. 25.—A long tabular list covering many pages, giving the name, date of laying, number of conductors, and length, of all the cables in the world, compiled from official information, by the International Bureau of Telegraphy; this is the seventh edition of that table. The number of cables under government control is 1141, with a total length of 19,883,878 nautical miles; those controlled by private companies number 318, with a total length of 143,023,812 nautical miles, making a total of 1459 cables, with a total length of 162,907,690 miles.

Telegraph Statistics.—Lond. *Elec. Eng.*, Dec. 3.—A translation of the tables from the *Jour. Telegraphique*, showing the relative progress of the various countries; it includes four pages of tables.

Marconi Telegraph.—Lond. *Elec. Rev.*, Dec. 3.—A translation of the article noticed in the *Digest*, Dec. 18, describing the recent experiments of Slaby. A brief abstract is published in the Lond. *Elec. Eng.*, Dec. 3.

Telegraphy. HESS. *L'Eclairage Elec.*, Nov. 27.—The beginning of an article on the chemical telegraph of Delaney, the synchronograph of Crehore and Squier, and the wireless system of Marconi; the present portion is devoted to the latter.

Losses Due to Lightning.—Elek. Zeit., Dec. 2.—A reprint of a short article on the losses in the telephone line at the Saentis.

Electric Efficiency of Translators. REDING. *Elek. Zeit.*, Dec. 2;—The beginning of a German translation, by the author, of his recent article (see *Digest*, Nov. 27).

Police Telephone Service in New York.—Elec. Eng., Dec. 16.—An illustrated description of the new plan proposed by McCullagh, the new chief of police; it consists essentially in the erection of a large number of substations not farther than five blocks apart, and located on the main thoroughfares, for police intercommunication.

Glasgow Telephone Inquiry.—Elec. Eng., Dec. 16.—A long communication from England on this subject, about which considerable has appeared recently in the English journals.

Infancy of the Telegraph.—Jour. of El'ty, Nov.—A short article on some of the very early records.

MISCELLANEOUS.

Gutta Percha.—Lond. *Elec.*, Dec. 3.—An editorial reference to the ingenious process of Serullas for extracting the gutta percha from the leaves of the isonandra gutta; the process was referred to in the *Digest* several years ago; the advantage lies not only in the salvation of the trees, but also that an improved quality of material is produced; Ramsay found it to be of exceptional quality; Lord Kelvin states that the results of his tests were "very remarkably satisfactory" in respect to the value of the gutta percha for submarine cables, and that a 10 per cent. increase of speed of signalling is thereby rendered possible; Hopkinson confirms this opinion, as his tests show that the material possesses exceedingly good insulating properties, higher than usually given in text books, while the specific inductive capacity is lower. A recent paper by OBACH on gutta percha is briefly noticed in the Lond. *Elec. Eng.*, Dec. 3.

Lithin, an Insulating Material.—Elek. Anz., Nov. 21.—Tables of results of tests made by the Reichsanstalt of this new material, made in Germany, which is intended to be used for apparatus, dynamos, transformers, etc., presumably to replace hard rubber and vulcanite. A plate immersed for seventy-two hours in water increased only 0.41 per cent. in weight; the tests give the insulation resistance before and after immersion in water; a plate 1 1-4 millimetres thick was pierced with 9300 volts.

New Welding Process.—Elek. Anz., Nov. 18.—A note describing a new process which is a modification of the well-known one of Lagrange and Hoho; by the latter process (which as may be remembered, consists in placing the metal in an electrolyte and passing a very strong current through it, which heats the part immersed), the parts welded together are apt to come apart or to break, which is claimed to be due to an improper application of the current, the temperature being apt to be too great; in the new process it appears that the metal is first heated in a forge or gas flame up to nearly the welding temperature and the parts are then compressed by a press while in an electrolytic bath, in which the parts are made the negative poles of a current passed through them only for a moment, in order to bring the metal to the welding temperature; no further details are given.

Voltage Regulator for Therapeutic Work.—L'Elec., Dec. 4.—An illustrated description of a device for using the continuous or alternating current from a lighting circuit, for therapeutical purposes; it consists essentially of a coil through which one ampere always passes and from different portions of which the required current is shunted off.

Electricity in Agriculture.—El'ty. Dec. 15.—An editorial on the recent

experiments in electroculture at Amherst. Beets, radishes, flowers and fruits are said to be greatly improved both in size and flavor, and the percentage of sugar in beets is increased; atmospheric electricity collected by the geomagnetiferè, and currents from dynamos, were used; beets that formerly yielded only 18 to 20 per cent. of sugar now yield from 25 to 30 per cent.; most of the crops have doubled; some of the lighter forms of vegetables, such as lettuce and spinach, have been hastened to maturity; certain plants thrived better under a red light; the fragrance of some flowers was increased. A recent newspaper account is quoted.

Biographical.—Elec. Rev., Dec. 15.—An abstract of the address by Barker on Moses G. Farmer, at the summer meeting of the American Institute of Electrical Engineers.

Book Reviews.

THE ELEMENTS OF ELECTRO-CHEMISTRY TREATED EXPERIMENTALLY, by Dr. Robert Lüpke. Translated from the second revised and enlarged edition, by M. M. Pattison Muir, fellow and lecturer of Gonville and Caius College, Cambridge. J. B. Lippincott Company, Philadelphia; 12mo. cloth, 224 pages, 54 illustrations. Price $2.50.

Although the main purpose of this book is to set forth the purely scientific aspects of electro-chemistry the practical sides of the subject have not been left entirely without notice. The process of electro-metallurgy, at present so important, and many technical electro-chemical processes are referred to in their proper places. The work gives an excellent resumé of more recent results, hitherto unavailable, except as articles in various journals, and such books of physical chemistry as those of Ostwald and Nernst. The book is written for readers having no more than a fundamental knowledge of the conception of physics and chemistry, and the various laws which have been deduced. The mathemetical discussions which have been introduced in a few places are only for the purpose of more complete confirmation of the purely physical argument of the work. The work is one which adapts itself especially to the needs of the lecturer and for practical teaching. The experiments which form so large a part of the book are for the most part simple, and arranged to be carried out with the simplest possible apparatus. Taken altogether, the book is a valuable addition to current technical literature and one that will no doubt be highly appreciated by many instructors and students. A considerable mass of valuable information is included in the numerous tables and formulæ with which it abounds. A complete and well arranged index adds no little to its value.

ELECTRIC SMELTING AND REFINING: The Extraction and Treatment of Metals by Means of the Electric Current. Being the second edition of Elektro-Metallurgie, by Dr. W. Borchers. Translated, with additions, by Walter G. McMillan. J. B. Lippincott Company, Philadelphia; 416 pages, 3 plates, 188 illustrations. Octavo, cloth. Price, $6.50.

It is hardly necessary to commend the admirable work of Dr. Borchers now brought before English readers in this translation. It forms a convenient compendium of information on the subject of electro-metallurgy and the various arts of metal reduction in which electricity plays a part. Electrolytic analysis, electro-plating and electrotyping have not been referred to in it. In the additional matter inserted in the text by the translator, the industrial aspect has been kept largely in view, and some supplementary notes have been added referring to actual applications of processes not otherwise referred to in the text. The rapid advance of practical applications of electro-metallurgy has made it peculiarly difficult to keep up with the literature of the subject, scattered as it is through a large mass of technical journals in many languages. The work of Mr. McMillan in this translation is therefore doubly valuable, and no doubt will be highly appreciated on account of the excellent exposition of the present state of the art which this book contains.

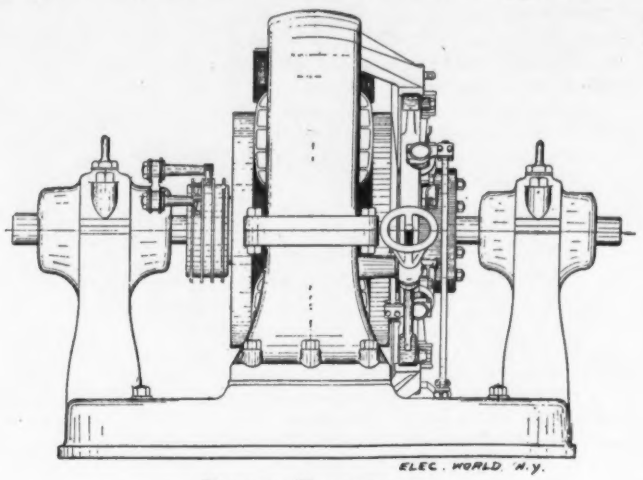
GAS, GASOLINE AND OIL VAPOR ENGINES: A New Book Descriptive of Their Theory and Power, Illustrating Their Design. Construction and operation for Stationary, Marine and Vehicle Motor Power. By Gardner D. Hiscox. Cloth; 8vo; 279 pages; 206 illustrations. New York: Norman W. Henley & Co. Price, $2.50.

In this book Mr. Hiscox has set out to describe the theory and construction of explosion motors from the poirt of view of American practice. The foreign books hitherto published and their English translation reprinted in this country have been exceedingly meagre in their treatment of American engines. This book has admirably succeeded in accomplishing its object, and the author is to be commended for his skillful and scientific treatment of his subject and the excellent arrangement of his work. The book is handsomely illustrated and well indexed, and the list of gas engine patents included in it will be found usefull by experimenters in this field.

Some New Alternating Apparatus.

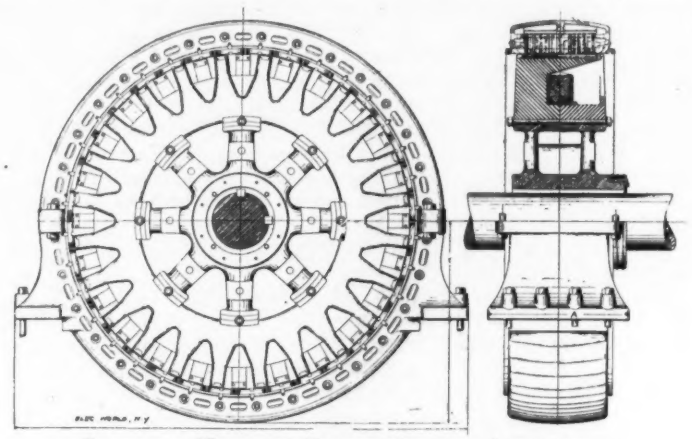
A new type of alternating generator has been brought out by the Walker Company, Cleveland, Ohio, in a number of sizes, and adapted for various uses in the transmission of power and electric lighting. In the design of the machine the revolving field type was adopted, with a stationary armature, which can be easily wound and insulated for any required pressure. The field coil is wound on an inductor of the inverted crown type, having teeth of alternately opposite polarities, and consists of a single coil revolving in its own plane and about its own axis. This field coil is double wound, so that the machine may be readily compounded if necessary. The standard frequency that has been adopted is sixty cycles per second, though machines of thirty cycles and 125 cycles are also manufactured. All classes of machines are wound for single, two and three phase current.

The main armature ring casting is made hollow, and an abundance of openings and air ducts passing radially through its mass permit ample ventilation. The field is made in two pieces, each having a number of radial arms, which are folded over at their outer extremities to form the pole faces. These are put together with the pole faces of each set of arms arranged between those



Rotary Transformer.

of the other, so that they are of alternate polarities. Each face is tipped with a block of steel laminations in order to avoid the formation of eddy currents. When the machine is to be used for incandescent lighting a commutator may be placed on one end of the inductor hub, having in its periphery as many bars as there are spokes on the inductor. The alternate bars are connected together and to the ends of the series winding of the field magnet. By this means a



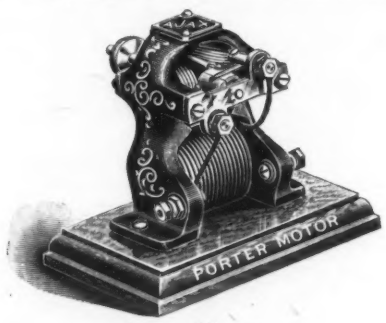
Sectional Views of Direct Coupled Alternator.

portion of the armature current can be rectified and used in a part of the field coil to produce the requisite overcompounding.

Included in the list of alternating machinery are rotary transformers in sizes from twenty-five kilowatts upward. So far these machines have been manufactured to work at thirty cycles, but it is expected that a 60-cycle type will soon be bought out.

The Ajax Battery Motor.

In this motor the Porter Standard Motor Company, Lebanon, N. H., offers everything that is possible to combine in a machine of its size in design, material, workmanship, finish, and, last but not least, efficiency. The manufacturing company believes that the Ajax motor is the best small motor ever put upon the market. This motor is finished in black or colored enamel decorated in gilt, with brass parts lacquered, or in full nickel throughout, as desired.



Ajax Motor.

Each motor is mounted on a finished wooden base, and will run on a single cell of battery, open or closed, dry or fluid. It is adapted to the operation of models and small mechanical devices, for advertising and other purposes, and is said to be in every way a perfect little machine. The armature is of the three-pole type. There is only one field winding, the pole-pieces being so designed as to constitute as well the frame work of the machine.

NEWS OF THE WEEK

Financial Intelligence.

TELEPHONE DIVIDEND.—The American Bell Telephone Company has declared a quarterly dividend of 3 per cent, and an extra dividend of 1½ per cent., payable on January 15, 1898. The last extra dividend, also of 1½ per cent., was paid July 15 last. The dividend just declared makes the total regular dividends for the year 12 per cent., and the extra 3 per cent., making a grand total of 15 per cent.

THE GROSS EARNINGS of the Edison Electric Illuminating Company, of New York, for the month of November, were $247,295.44, an increase of $21,766.04 as compared with the gross earnings during the corresponding month of last year. The net earnings were $120,568.20, an increase of $8,642.38. The gross earnings for the eleven months ended November show an increase of $204,468.06 as compared with the corresponding period last year, and net earnings show an increase of $130,645.55.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, N. Y., has declared a quarterly dividend of 1½ per cent., payable January 15, 1898. The report of the company for the month of November, this year, shows gross earnings of $86,582, an increase of $5,157, as compared with the same month of last year. and net $43,372, an increase of $1,471. For the eleven months ending November 30, the gross earnings were $795,071, an increase of $50,681, as compared with the corresponding period of last year, and net $361,409, an increase of $28,473.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK. Dec. 20. 1897.

MR. F. R. CHINNOCK has been appointed agent for New York State for the sale of the apparatus of the Triumph Electric Company, Cincinnati, Ohio. He has opened an office at 39 Cortlandt Street.

THE STRIKE of the electrical appliance makers at the factory in this city of the Western Electric Company, which was referred to in the last issue of THE ELECTRICAL WORLD, has been settled. It is stated that concessions were made on both sides in effecting a settlement of the differences.

NEW YEAR'S RECEPTION.—Messrs. Godfrey, Harrington & Olson, of the India Rubber & Gutta Percha Insulating Company, 15 Cortlandt Street, will hold their usual New Year's reception at their offices between 1 and 6 o'clock P. M., December 31. They are distributing invitations to the electrical fraternity.

ELECTRIC RAILWAYS IN TOKIO, JAPAN.—It is stated that the Japanese Government will grant permission for the building of electric railways in the Japanese capital. The sole concession to carry on this enterprise is being sought by various agents. Local firms identified with the Japan trade state that on account of the superiority of American electric railway apparatus and equipment the chances of the majority of the orders for the Tokio railways coming to America are excellent.

TELEGRAPH EXTENSIONS.—The directors of the Postal Telegraph & Cable Company have decided to expend $1,000,000 in the extension of the company's system in the West and Southwest. It is proposed to build lines from Leadville, Col., to Ogden and Salt Lake City, and to Helena, Mont., thus securing a connection between the Rocky Mountain and Canadian Pacific systems. The company's lines are also to be extended in Texas, making connections at Laredo with the Mexican Central and Mexican National Railway systems.

THE ELECTRIC VEHICLE COMPANY has taken over the business, property and rights of the Electric Carriage & Wagon Company, of this city, and intends to extend the electric cab business and carry it on on a large scale. Fifty coupés and fifty hansom cabs will be placed in service as soon as they can be constructed and delivered. It is expected that the new carriages will be in operation in the early spring. It is stated that the practicability of the electric vehicle has been proved, and that the financial results have been satisfactory. These vehicles have been attractive to the public.

THE THIRD ANNUAL CONVENTION of the National Association of Manufacturers will be held in the Masonic Temple, at the corner of Twenty-third Street and Sixth Avenue, this city, on January 25, 26 and 27, 1898. The headquarters of the association will be at the Waldorf-Astoria. The grand banquet will be held at the same hotel, and will probably be the largest ever given in any hotel. This association was formed in January, 1895, for the performance of any service which the manufacturers of the United States require. Upon this basis the association has developed into a powerful organization, embracing in its membership upward of 1000 of the largest manufacturers, representing every important industry and every prominent industrial centre of the country. Among the objects of the association are the securing of improvement in the patent laws, the investigation of foreign markets, the restoration of the American merchant marine and the careful investigation of possible new markets for American products. In carrying out the last object a study is made of the trade conditions in various countries, with the conditions of competition which must be met.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Build'ng, 620 Atlantic Ave,
BOSTON, Mass., Dec. 18, 1897.

THE MANCHESTER ELECTRIC COMPANY, Manchester, N. H., will give a lunch and reception on Wednesday, December 22, to a large number of invited guests, to celebrate the completion of the extensive enlargements and improvements of the company's plant. Mr. G. Byron Chandler is vice-president, and Mr. J. Brodie Smith superintendent.

THE MODIFIED LEASE of the West End Street Railway, Boston, was approved to-day by the Board of Railroad Commissioners. The objections noted in the first lease by the commissioners were modified in the second to a twenty-five-year term and a 7 per cent. dividend. The active work of construction, it is stated, will be commenced as soon as the architectural and detail plans have been submitted and approved by the Railroad Commissioners.

OYSTER FEAST AT EAST BERLIN.—About 1000 persons were present at the fifth annual oyster roast given on the evening of December 15, by the Berlin Iron Bridge Company, East Berlin, Conn., to its employees and their families. Many prominent persons from Hartford, New Haven and other places availed themselves of the company's invitation to participate, and materially added to the enjoyment of the occasion. President Charles M. Jarvis, Vice-President Burr K. Field and the officers of the company received and welcomed the guests, who were afterward given an opportunity to inspect the extensive works. The oyster roast was served in the forging building, in which long tables had been arranged for the accommodation of the guests. The feast was enlivened by music and general merriment, and thoroughly enjoyed by all present.

SOUTHERN NOTES.

WASHINGTON, D C., Dec. 18, 1897.

A NEW TELEPHONE LINE is being constructed between Warren Point and Raleigh, N. C.

THE BELL TELEPHONE COMPANY is perfecting arrangements at Raleigh, N. C., for the extension of its line into the more important parts of the State. It is reported that the company has appropriated $300,000 for the erection of telephone lines to North Carolina towns, and that the work will be commenced at an early date. Raleigh will be the headquarters of all the lines in that section.

A PRIVATE TELEPHONE SYSTEM is to be installed on the piers and in the yards of the Chesapeake & Ohio Railway Company, arrangements having been made for that purpose between the Railroad Company and the Bell Telephone Company. The system will be used exclusively by the railroad company for the transaction of its business. A central office will be established on one of the piers, where connection may be made with the city system and the long-distance lines to Richmond. This improvement, it is stated, will greatly facilitate the transaction of the railway company's Norfolk business.

RELIEF FOR WAR TELEGRAPHERS.—A bill was introduced in the House of Representatives recently, by request, for the relief of telegraph operators during the civil war. The bill provides that members of the United States Military Telegraph Service shall be entitled to the same rights of homestead entry and pension as are now allowed to other persons who were in the army. It also provides that such operators who deserve the distinction shall be given appropriate medals for their services, and certificates of honorable discharge. The bill was referred to the Committee on Invalid Pensions.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Dec. 17, 1897.

MUNICIPAL LIGHTING IN TONAWANDA.—The proposition to set up a municipal electric light plant in Tonawanda is finding more favor, and is quite likely to be tried, especially since the quality of light furnished by the companies has never been satisfactory. It is estimated that a saving of something like $50,000 can be made in this way.

MR. JUSTUS ECK, who has just closed a visit to Buffalo and Niagara Falls in the interest of Laing, Wharton & Down, electrical engineers, of London, acknowledges freely that Europe is obliged to come to America to learn the latest things in electricity. Electrical work here is not only more thoroughly done, he says, but it is carried further than it has yet been in Europe. Mr. Eck went West, and will visit the principal cities of the country.

COLLAPSE OF THE NIAGARA WHEEL PIT AVERTED.—It has been an open secret among the members of the Cataract Construction Company since last August that the walls of the big wheel pit were creeping in toward each other, and all the ingenuity of the company's staff has been so taken up with measures for stopping this threatened collapse that nothing could be done with the Canadian grant until it was stopped. This was done some time ago, and so effectually that the secretary is now willing to make the matter public as something no longer to be feared. He does not say what was done or why the walls of rock threatened to fall.

THE BUFFALO, HAMBURG & AURORA ELECTRIC RAILWAY COMPANY has received the consents of all property owners on the line, and will ask for construction bids to be opened about the middle of January. The line will be 19 miles long, and will cross no steam roads at grade. Manager U. L. Upson expects to have cars running by July next. The power house will be situated in Hamburg. It will have 300-hp capacity, and a storage battery plant that will add about 200 horse-power. The engine house plant will cost about $25,000. It was at first thought best to use Niagara power, but the cost of transformers and other apparatus was found to be too high.

MR. W. B. RANKINE, secretary of the Cataract Construction Company, spent port of the week at Niagara Falls in connection with the work on the transmission line to Buffalo and the development of power on the Canada side of the Falls. He says that the Canadians have been stirred up on the subject of electric power by some Americans, who took that method of getting into the Cataract Company. He announces that an arrangement has been made with the Niagara Falls Park & River Railway Company to furnish 500 electric horse-power to any Canadian consumer desiring it at once, and to furnish 1000 horse-power in six months. Mr. Rankine says he sees no prospect of the early erection of factories in Canada that will need electric power, and appears to look on all the late talk of such activity as idle. Mr. Rankine's action, however, does not appear to have stopped the move for an independent Canadian power plant at Niagara Falls, as an office has been opened by the Canadian Power Company, with Mr. John S. Macklem in charge. It is stated that the Canadian Company will within five months be able to furnish 5000 horse-power at any convenient point. The power is to come from the Niagara Falls Park & River Railway plant.

Chicago Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Dec. 17, 1897.

THE SOUTH SIDE ELEVATED RAILROAD COMPANY has, on the recommendation of the president and engineers, adopted the Sprague multiple system for the operation of its road. The service test on the Metropolitan line, of the five coaches equipped with Sprague apparatus, proved, it is said, very satisfactory.

THE BADGER ELECTRIC COMPANY, Racine, Wis., has recently installed a Ball compound condensing engine direct connected to two 75-kw, 110-volt generators, and has changed over the business district from alternating to the three-wire direct-current system. It now furnishes a day current for light and power.

MESSRS. M'KINLOCK & CAMP, late of the Metropolitan Electric Company, have just moved to large and handsome quarters, at 175 Randolph Street. The offices will be furnished with oak fixtures, and the storage department will be fitted up with a combination passenger and freight elevator. These gentlemen are now in a position to do a large business, in which their many friends wish them every success.

THE FORT WAYNE ELECTRIC CORPORATION is increasing its manufacturing facilities at Fort Wayne, Ind., and will erect two buildings, one of which will be a structure of brick and steel. It will be 206 feet in length, 69 feet wide and 35 feet high, having two stories. The other building, which will be entirely of brick, will be 141 feet long, 33 feet wide and one story high. The latter building will be used as a testing and calibrating laboratory. The larger building will contain a traveling crane running the entire length of the structure for the purpose of handling heavy materials and apparatus. These improvements, it is stated, will involve an outlay of about a quarter of a million dollars, and will double the present capacity of the plant. They will also enable the company to handle a much larger working force, and it is stated that fully 300 more hands will be employed. These increased facilities have been rendered necessary by the growing demand for its apparatus.

Milwaukee Notes.

MILWAUKEE, Wis., Dec. 16, 1897.

THE LANCASTER, WIS., CITY COUNCIL has voted a franchise for an electric lighting plant.

THE EDGERTON ELECTRIC LIGHT COMPANY, Edgerton, Wis., has installed a Warren 1500-light induction type alternator at its new station at Indian Ford. The station was formerly at Fulton.

SUIT HAS BEEN BROUGHT against the Wisconsin Telephone Company by the city of Sheboygan, Wis., to force the company to remove its lines from the city. The trouble is the result of the company entering the city before a franchise was granted to it.

THE BELOIT ELECTRIC LIGHT COMPANY is the name of a new company formed at Beloit, Wis., for the purchase of the electric light plant of G. L. Cole and M. H. Taylor. The new company includes A. E. Smith and Manager E. G. Cowdery, of the Milwaukee Gas Light Company, and G. L. Cole, of Beloit.

THE LONGEST ELECTRIC RAILWAY in the world will terminate at Lake Geneva, Wis. The road will start at Kankakee, Ill., and run through Wilmington, Joliet, Elgin and Sycamore. Although the project is not fully settled, it is assured. The right of way from the terminus of the Kankakee & Bourbannes line through Kankakee County to Morris has been secured, as has also the capital to construct it. From Morris the new road will extend to Sycamore and Northern Illinois towns, and thence to Geneva Lake. It will traverse a section of the county not accommodated by steam railways from north to south, and will also connect with many existing lines between Chicago and points west. The capital stock of both companies will exceed $400,000. The names and corporations that will unite to form the line are: Kankakee, Wilmington & Morris, the Geneva Lake and Sycamore & Southern. Both roads will be constructed within one year.

Texas Notes.

SAN ANTONIO, Texas, Dec. 14, 1897.

ELECTRIC LIGHT PLANT FOR BEEVILLE.—The matter of establishing an electric light plant at Beeville, Tex., is being agitated. P. J. Smith, of San Antonio, is the promoter of the enterprise. It is stated that a considerable amount of money has been subscribed by the people of Beeville for the proposed plant.

THE CITY COUNCIL OF CUERO, TEX., has granted Otto Buchel and associates a franchise to string wires in that city for both power and light purposes. The promoters of the enterprise have almost completed a rock dam and power house on the Guadalupe River, 3 miles from Cuero, at a cost of $75,000. It is the intention of the company to furnish electricity for both light and power.

THE SALE OF THE DALLAS CITY STREET RAILWAY COMPANY'S property took place on December 7 at the court house door in Dallas, by Special Commissioner C. E. Baird, on foreclosure of the first mortgage bonds, to C. H. Alexander, of Dallas, for $267,000. Mr. Alexander is a well-known capitalist, and announces that in buying the road he represented himself and associates, all of whom are citizens of Dallas. The road is an electric line, and Mr. Alexander states that it is to be greatly improved. New electrical machinery will be purchased, and the road equipped with new rolling stock. The purchasers also propose to establish a large electric light plant in connection with the railway power station.

MR. THOMAS H. M'LEAN, general manager of the Federal District Street Railway, of the city of Mexico, spent a few days of last week in San Antonio. He stated to your correspondent that the London syndicate owning the railway system of which he is manager proposes to equip 37 miles with electric power, and that the work of transformation will begin January 1. It was the original intention to use water power for the generation of the electric power, but an investigation showed that steam would be less expensive, and the latter will be used. There has been a big increase in the earnings of the road, and the syndicate is more than pleased with the property as a good investment. Mr. McLean was formerly a prominent figure in street railway circles in New York, Indianapolis and Pittsburg. This is his first visit to the United States since he took charge of the city of Mexico system nearly two years ago.

Pacific Coast Notes.

SAN FRANCISCO, Cal., Dec. 10, 1897.

AN INDEPENDENT TELEPHONE LINE is projected between Rumsey, Cal., and Capay. Citizens will subscribe stock enough to insure the construction of the line.

THE CITY OF RIVERSIDE, CAL., which maintains a sub-station and distributing system, and sells electricity for light and power purposes, has increased the capacity of its sub-station, and will probably extend the service to neighboring towns. The main generating station is in Redlands.

THE YOUNG LADIES in San José, Cal., who took charge of a number of street cars on the San José & Santa Clara electric line, and the San José & Alum Rock motor line for one day, netted $350 for the Associated Charities. The cars were decorated with flowers to an extent that only Californians could indulge in. Many gentlemen refused to accept change, and the affair was a great credit to all concerned.

THE SAN GABRIEL ELECTRIC COMPANY is pushing the hydraulic work, including tunnels, night and day in order to supply current in Los Angeles by February 1. Bids were recently opened by Consulting Engineers Hasson & Hunt, of San Francisco, for the three double water wheels required. It is understood that Tuthill wheels, manufactured by the Oakland (Cal.) Iron Works Company, were decided to be the best suited for the purpose.

AN ELECTRIC LIGHT PLANT FOR ONE DOLLAR.—The San Diego, Cal., city lighting contract was recently awarded to the San Diego Gas & Electric Company for a term of one year, from April 1, 1898, with arc lights of 2000 candle power. The company's original bid was $10 per lamp per month, on moonlight schedule. J. F. McCrosson, of San Francisco, has offered to furnish 25 per cent. more light than the above company at a cost to the city of $1500 per month, for a term of five years, and at the expiration of that period to present his plant to the city for the sum of $1.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY has a number of new exchanges and short lines projected that will be in operation next year. Among these will be a branch line from Monterey, Cal., to Seaside, the line from Coulterville to Mariposa, a line to connect Los Banos, Cal., with the Sunset system; an exchange in Santa Ana, Cal.; an exchange in Oakdale, Wash.; a line from Bear Valley to Coulterville, Cal., which will make a circuit of the mountain towns, and through the Inland Telephone Company, a line from Heppner, Ore., to Arlington. A line will be constructed at once from Yreka, Cal., to Scott Valley, thence to Weaverville, where it will join the long distance lines of the Sunset Company.

General News.

New Incorporations.

THE PARK GATE & ELWOOD STREET RAILWAY COMPANY, Elwood City, Pa., has been incorporated by Thomas Dugar and others, with a capital stock of $25,000.

THE VALLEY ELECTRIC COMPANY, New Brighton, Pa., has been chartered, with a capital stock of $1,000. Senator White, of Beaver, Pa., is president of the company.

THE LYKENS & WILLIAMS VALLEY STREET RAILWAY COMPANY, Lykens, Pa., has been organized, with a capital stock of $250,000. John B. Skyles, of Martinsburg, Pa., is president.

THE ALTHEIMER LONG DISTANCE TELEPHONE COMPANY, Little Rock, Ark.; capital stock, $25,000. Incorporators are J. H. Moon, W. H. Bellamy, N. T. White and Dr. D. C. Walt.

SOUTHWEST ARKANSAS TELEPHONE COMPANY, Prescott, Ark., has been incorporated, with a capital stock of $5,000. The incorporators are W. C. Wingfield, C. B. Gale and J. T. Abraham.

THE CHIPPEWA FALLS TELEPHONE COMPANY, Chippewa Falls, Wis., has filed articles of incorporation, with a capital stock of $25,000. The incorporators are George B. Earley, Philip Loewe and T. J. Connor, all of Chippewa.

MONTGOMERY ELECTRIC LIGHT & POWER COMPANY, Lycoming County, Pa., has been incorporated at Harrisburg, Pa. The directors are Charles W. Fehr, William Decker, John Meixell, Robert A. Sechler, J. Scutter Shoemaker and D. W. Shollenberg. Capital stock, $7,000.

THE TELEGRAPH AND TELEPHONE.

DAVENPORT, IA.—The Iowa Telephone Company's long-distance line between this city and Dubuque is all ready for business.

NASHUA, IA.—The Cedar Valley Telephone Company has commenced building a line from Waverley to Nashua, a distance of about 20 miles.

FORT PIERRE, S. DAK.—A telephone line is being run from this place to Rapid City, S. Dak. The projectors of the enterprise are Messrs. Rowe Brothers.

BOSTON, MASS.—The Erie Telegraph and Telephone Company added 335 subscribers to its system during the month of November, making the total connections at the close of that month 24,222.

LEROY, ILL.—Mr. B. F. Wasson, of Lincoln, Ill., has just completed telephone lines from all the towns in Dewitt County to Leroy, and will soon commence work on an exchange in Farmer City, and will install there a 100-drop switchboard.

VERMILLION, S. D.—The Southwestern Telephone Exchange Company has completed its line to this city from the east and is now working west to Yankton. This city now has direct telephone communication with Minneapolis and St. Paul.

VISALIA, CAL.—The Mt. Whitney telephone line, 150 miles in length, connecting Visalia, Tulare, Porterville and Bakersfield, has been sold for $2500 to satisfy a judgment. The telephone company will be reorganized, and the line operated.

FORT WAYNE, IND.—At the annual meeting of the stockholders of the Home Telephone Company in this city, the report of the officers showed that there are now 1295 instruments in use by the company's subscribers. The service is being improved in every possible way and far outclasses that ever before enjoyed by the people of Fort Wayne. The following named gentlemen were elected officers for the ensuing year: President, George W. Beers; vice-president, Charles S. Bash; secretary, John W. Sale; treasurer, Charles McCulloch.

INDIANAPOLIS, IND.—The Kurtz National Telephone Company, of the State of Indiana, whose incorporation was noted in THE ELECTRICAL WORLD of October 23 last, has been organized and the following named gentlemen elected as officers: Wm. H. Dye, president; J. V. Mitchell, secretary; John N. Cobb, Treasurer, and William J. Kurtz, vice-president and manager. The capital of the company is $50,000. The company is authorized to do business in every county in the State. It has a model plant of 220 'phones in operation at Martinsville, Ind., and four towns are connected by toll lines.

ELECTRIC LIGHT AND POWER.

MADISON, N. J.—The electric light plant will be enlarged.

NEWPORT, VT.—The electric light plant at this place will be enlarged.

MITCHELLVILLE, IA.—This place contemplates a $10,000 municipal electric light plant.

SPRING GREEN, WIS.—The citizens expect soon to establish an electric light plant.

EAST CLEVELAND, O.—The city has voted to issue $5,000 in bonds for electric lights.

MORRISTOWN, TENN.—The city of Morristown has purchased the electric light plant in this place.

COFFEYVILLE, KAN.—The citizens have voted in favor of issuing bonds to build an electric light plant.

TONAWANDA, N. Y.—The Board of Trustees has decided to establish a municipal electric lighting plant.

CLINTON, N. Y.—An electric lighting plant will either be erected by the city or private parties, to light the streets.

WILLIAMSPORT, PA.—At a meeting of South Side Council it was decided to advertise for bids for lighting the streets.

JOPLIN, MO.—The Southwest Missouri Light Company is arranging to put in a $50,000 electric light plant at this place.

LITTLE FALLS, N. Y.—The Dolgeville Electric Light & Power Company have petitioned the Common Council to operate in this city.

SCRANTON, PA.—An ordinance has been introduced for creating a city debt for the construction of a municipal electric light plant.

PATTON, PA.—Geo. S. Good has been granted a franchise for an electric light plant in this city. Dynamos and machinery will be purchased.

PUEBLO, COL.—The City Council has appointed a special committee to investigate the feasibility of city ownership of an electric light plant.

SYRACUSE, N. Y.—A new electric light company is to be organized in this city. The promoters are Eugene Hughes, Col. John F. Gaynor, and others.

DOWNINGTOWN, PA.—The citizens are in favor of erecting a municipal electric lighting plant. Mr. J. T. Carpenter is interested in the movement.

HOLYOKE, MASS.—The Board of Aldermen have decided to call an election to vote upon the proposition of constructing a municipal electric lighting plant.

CADIZ, OHIO.—The Cadiz Electric Light & Power Company will improve its plant by the addition of one 100-hp engine and one alternator of 60-kw capacity.

NEW BRIGHTON, S. I., N. Y.—The New Brighton Board of Trustees decided to establish a street light district in the Fifth and Sixth Wards. The cost will be $18,000.

HOUSTON, TEX.—The city will vote upon the proposition to issue $100,000 of municipal bonds, to be used in erecting an electric lighting plant, to be owned and operated by the city.

LORAIN, O.—The Lake Erie Electric Light Company and the Wright Gas Company of this place have been consolidated. The capital of the consolidated company will be increased to $150,000.

SHELTON, CONN.—The H. Wales Lines Company signed a contract with A. & S. Blumenthal, New York City, for the erection of a silk velvet mill at this place. The machinery will be run by electricity.

BLUE MOUND, ILL.—The Council has under consideration a proposition to equip an electric light plant. John F. Stock, connected with the Clinton Machine Works, Clinton, Ill., proposes to put in a plant.

SOMERSET, KY.—Mr. Beecher Smith, of this city, has received the franchise to light this place by electricity, and is now in the market for the entire equipment for a large electrical plant. He needs engines, dynamos, etc.

CINCINNATI, O.—Surveyor Lemon has recommended that the Government Building be provided with an electric light plant to cost from $35,000 to $40,000. Senator Foraker will ask Congress for an appropriation for the purpose.

WINNIPEG, MAN.—The City Council has ordered plans and specifications for a 200 are light municipal electric system. It has also been decided to call for tenders for the installation of such a plant, together with a 100 box fire alarm system.

DAYTON, ILL.—The Western Cottage Piano & Organ Company, whose factory is in this city, has purchased the rights to a water power 3.1 miles from its factory. It proposes to develop this power and transmit it electrically to motors suitable for the necessary power generation throughout the works.

NEW BRIGHTON, S. I., N. Y.—The bid of the New York & Staten Island Electric Company to light the streets of New Brighton during the next five years has been accepted by the New Brighton Board of Trustees. The rates to be paid are $17.25 per annum for each incandescent lamp, and $100 per annum for each arc light.

PORT HURON, MICH.—Preliminary steps have been taken for the establishment of a competing electric and power plant in this city. The Common Council granted Seward L. Merriam, Edward F. Percival and Chas. Wellman a franchise for such a purpose. The contract for street lighting with the present company expires next October.

WOOSTER, O.—At the meeting of the council, President Zaring called the attention of the members to the fact that in June next the contract with the electric light company would expire, and suggested that all should begin to inform themselves on the question that they would be called upon to either make a new contract or build a plant for the city.

WORCESTER, MASS.—The Worcester Electric Light Company is making extensive improvements at its station in this city, and has added eight new General Electric dynamos. Two of the machines are 3000-light alternators. A new and completely equipped alternating switchboard will also be installed. It will be 37 feet 6 inches long and 9 feet high, and constructed of blue Vermont marble.

ATCHISON, KAN.—Arrangements have been made for the consolidation of the Atchison Street Railway, Light & Power Company, and the Atchison Gas, Electric Light & Power Company, the former company being the purchaser of the latter. All of the machinery, boilers, engines, etc., of the latter named company will be removed to the power house of the street railway company. The consolidation closes competition.

THE ELECTRIC RAILWAY.

WEBSTER, MASS.—The Webster-Dudley Street Railway will be built.

BRIDGEPORT, CONN.—The Shelton Street Railway Company proposes to extend its line from Shelton to Bridgeport.

NORTHAMPTON, MASS.—The Northampton Street Railway Company has been granted a franchise to operate in the city.

FITCHBURG, MASS.—The Fitchburg & Leominster Street Railway Company has petitioned the city for a franchise to operate its lines in the city.

HAMDEN, CONN.—It is proposed to extend the trolley line from this place to Mt. Carmel, by the New Haven & East Haven Street Railway Company.

PIEDMONT, N. Y.—Mr. A. B. Wilgus, representing the Nyack Traction Company, has petitioned the Board of Trustees for a franchise to run an electric road through the village.

CATOCTIN, MD.—Surveys for the proposed Catoctin & Myersville Electric Road have been completed, and the directors propose to begin building as soon as estimates of the cost are received.

CRANFORD, N. J.—President Chandler W. Riker, of the Westfield & Elizabeth Street Railway Company, has petitioned the Township Committee to operate a trolley road in the township.

SHAMOKIN, PA.—The North Susquehanna Transit Company will construct an electric railway from this city to Danville, Bloomsburg and Espy. Gibson & Rhinehelter, of Philadelphia, Pa., are interested.

BROOKLYN, N. Y.—Application was made before the Village Trustees of Flushing, L. I., N. Y., by the Cross County Railroad Company, for a franchise to construct and operate a double track electric street surface railroad in that village.

ZANESVILLE, OHIO.—The Zanesville Street Railway & Electric Company has been placed in the hands of a receiver. The bonded indebtedness is said to be $200,000, and the floating debt $75,000. Mr. William Christie was appointed receiver.

HAMILTON, OHIO,—The Hamilton, Venice & O'Keana Electric Railway Company has secured the right of way from Scipio to Mixerville. The road will connect Hamilton and College Corner, and it is the purpose of the company to extend the line later on to Richmond, Ind.

JERSEY CITY, N. J.—The Consolidated Traction Company has receded from its determination to contest the vestibule law, and decided to equip its cars in this city, Newark and Elizabeth with vestibules, according to the requirements of the new law, which becomes operative on January 1, 1898.

NEW YORK CITY.—At the annual meeting of the Staten Island Midland Railroad Company the following named gentlemen were elected as officers for the ensuing year: William B. Rockwell, president and general manager; Robert Wetherill, vice-president; Richard Wetherill, secretary and treasurer.

MARIETTA, OHIO.—A company of Marietta people is making plans for an electric railway line between here and Newport, 16 miles up the river. The old Ohio Valley Railroad route, which was abandoned by General Warner and associates after grading, will be used if the new project is carried out.

BRUNSWICK, ME.—A company has been formed to purchase the Lewiston, Brunswick and Bath electric railways at a cost of a quarter of a million dollars. Mr. M. T. Shaw, of Bath, has been elected president; A. F. Gerald, of Fairfield, vice-president and general manager, and Hon. I. C. Libby, of Waterville, treasurer.

WHITINSVILLE, MASS.—The directors of the Blackstone Valley Railway Company have accepted the franchise granted by the Board of Selectmen, and have begun work extending the line from Farnumsville to Northbridge. It is stated that the company will petition the Northbridge authorities for permission to extend the road into Whitinsville.

SYRACUSE, N. Y.—Electric locomotives will be used on the projected Syracuse, Skaneateles & Moravia Railway. There will be two power stations, and the overhead system of construction will be adopted. The locomotives will have two four-wheel trucks, each pair of wheels being equipped with a 200-hp motor. It is stated that it will be possible to draw the train at a speed of a mile a minute. The engines will be provided with air brakes.

ALBERT LEA, MINN.—Local capitalists, headed by G. L. Carrington, have secured a franchise for the construction of an electric railway from this city to Geneva, a distance of 15 miles. The road will run through the towns of Bancroft and Clark Grove. Geneva is not touched by a railroad, and it is believed that the projected electric line will be liberally patronized. It will handle passengers, freight and mails. The cost of the line is estimated at $150,000, and it will be the first rural electric railroad established in this State.

CLEVELAND, OHIO,—The Cleveland, Berea & Elyria and the Elyria & Oberlin electric railway lines have been consolidated. It has been decided to call the new company the Cleveland, Berea, Elyria & Oberlin Electric Railway Company, and it will be capitalized in the sum of $1,000,000. Under the State law it is necessary to have the headquarters of such a line at some point other than either terminal, and in compliance therewith the headquarters will be established at Berea, although the main offices will be in this city. Mr. A. H. Pomeroy, of Berea, has been elected president; A. E. Akins, vice-president, and Levi Meacham, secretary.

PHILADELPHIA, PA.—The report from Camden, N. J., to the effect that the Pennsylvania Railroad Company had decided to introduce the overhead trolley system on some of its branch lines is officially denied. The company's experience with electricity on its Mt. Holly branch has, it is stated, settled one point, and that is that trains must be run very close together in point of time to make electricity an economical motive power. The Pennsylvania officials hint that if electricity is adopted on any of the lines it will be first put on the Atlantic City service, and trains will be run from Philadelphia, to the sea.

Personal Note.

MR. JAMES TODD, president of the Sterling Varnish Company, Pittsburg, Pa., was married on December 7 to Miss Mary Louise Slagle, daughter of Judge Jacob F. Slagle. Mr. Todd's many friends extend their congratulations and wishes for a very happy future to the young couple.

Trade and Industrial Notes.

THE DAVIS & EGAN MACHINE TOOL COMPANY, Cincinnati, Ohio, is now represented in St. Louis by Mr. W. J. Corrington.

THE U. S. ELECTRICAL SUPPLY COMPANY, 120 Liberty Street, New York City, is placing upon the market apparatus for wireless telegraphy.

THE B. & H. ELECTRIC COMPANY, New Haven, Conn., is preparing to construct a telephone exchange of 100 subscribers, and is in the market for the necessary material.

MESSRS. BROOMELL, SCHMIDT & CO., Limited, York, Pa., manufacturers of the American Fuel Economizer, have received among other orders one for an economizer to be shipped to Yokohama, Japan. Among recent shipments abroad was an economizer for Johannesburg, South Africa.

THE YOUNGSTOWN BRIDGE COMPANY, Youngstown, Ohio, whose plant was recently destroyed by fire, has a force of more than 200 men working night and day on its new works, which, when completed, will be twice the size of the former plant. The company expects to have its new works in full operation soon after the first of the year.

A "CLEVERLY" DESIGNED CALENDAR.—A wall calendar for 1898 of ample proportions, and containing a beautiful engraving on which to feast the eyes, is being issued by the Cleverly Electrical Works, Philadelphia, Pa. The picture represents "An Old New England Mill," and is a typical scene of an early industry, now almost unknown except in poetry.

MESSRS. MEYSENBURG & BADT, Chicago, Ill., Western representatives of the Weston Electrical Instrument Company, have just issued their 1898 price list of Weston instruments. It includes all classes of instruments manufactured by the Weston Company. The firm also carries on a business as brokers, contractors and engineers in electric lighting, power, railways, etc.

REMOVAL NOTICE.—Messrs. John Y. Parke & Co., dealers in electrical supplies, Philadelphia, Pa., announce their removal from their old quarters at 821 Cherry Street to 724-728 the same street. At their new stand they secure increased floor space, which, together with new and improved machinery, will place the firm in a position that will enable it to give more prompt attention to work intrusted to it.

THE NEW "STANDARD" DRY BATTERY, manufactured by William Roche, 259 Greenwich Street, New York, and recently introduced to the public, seems to be growing in popularity, judging from the orders received as the result of tests of sample cells. Mr. Roche states that he has already received inquiries from nearly every State in the Union and from some of the most reputable concerns. He therefore feels very much gratified.

THE WALKER COMPANY has just issued a series of four circulars describing its alternating apparatus, the Walker pivotal trolley, with Grover trolley bed, and the "S" solenoid blow-out controller. The fourth describes methods of generator construction, and shows a few points of difference and superiority in the Walker generator compared with those of other makes. Each circular by the aid of illustrations sets forth its subject very clearly.

THE AMERICAN ELECTRICAL WORKS' CHRISTMAS GREETING.—As the years roll by the American Electrical Works, Providence, R. I., headed by the inimitable Eugene F. Phillips, never fails to do something original and appropriate at Christmastide. This year it is sending out to the trade a folder on which is printed a picture of a Christmas tree loaded with presents for everyone to whom the ordinary mortal is bound by a tie of some sort. Even the cat is remembered.

THE WARREN ELECTRIC MANUFACTURING COMPANY, of Sandusky, Ohio, in its November bulletin describes and illustrates the Warren alternator. Photographic facsimiles of voltmeter records taken off lines on which Warren induction alternators are used show the excellent regulation attained. The various constituent parts of the Warren machines are illustrated in half-tone engravings. A view of the interior of part of the company's works and an exterior view of the works are also shown.

MESSRS. PURDY & HUBBARD, electrical engineers and contractors, Bowling Green Building, New York City, have taken the New York agency for the Bernstein Electric Company, Boston. The firm will soon place upon the market a new motor. Both Messrs. Purdy and Hibbard are well known in the electrical trade. Mr. Purdy is a former station manager and construction man, having, during the past fourteen years, been connected with the Excelsior Electric Company and the Canandaigua Electric Light & Railway Company. Mr. Hibbard was connected with the General Electric Company for about eight years, and latterly with the Columbia Electric Supply Company, of New York.

A COMPLETE INCANDESCENT LAMP CATALOGUE.—The General Electric Company recently issued a very complete catalogue of Edison incandescent lamps. It is very artistically executed, and constitutes nothing more or less than a treatise on incandescent lamps from the customer's point of view. The catalogue contains chapters on the production, selection and use of lamps, and gives descriptions of the various types, accompanied by full sized illustrations of each lamp described. The General Electric Company, according to the catalogue, manufactures over 30,000 varieties of lamps, including the various voltages and candle powers, and produces and sells annually over 6,500,000. A great deal of valuable information about lamps is given, and altogether the catalogue forms one of the most interesting and valuable and at the same time practical works on this subject ever produced.

MR. HUGO REISINGER, sole agent for the "Electra" highest grade Nuernberg carbons, writes us as follows, with reference to the statements recently published: "I wish to inform the trade that the word 'Electra' has been properly registered by me as my trade-mark, and therefore cannot be used by anybody else without infringing on my rights. The 'Electra' carbons are manufactured as heretofore by the world-renowned firm of C. Conradty, Nuernberg, who owns not only the oldest, but the most extensive carbon works in existence, and whose carbons remain unequalled in quality and efficiency, having become the standard for electric lighting the world over. As to parties reported as makers of the 'Electra' carbons, I wish to state that I have brought suit against them for having misused the trade-mark 'Electra,' and that they have been enjoined by the Nuernberg courts from making any carbons stamped 'Electra,' under penalty of 100 marks for each carbon. I shall guard the interest of buyers of my carbons as heretofore, and any information in regard to infringements on the registered trade-mark 'Electra' that will enable me to take legal proceedings, will oblige."

THE WILLARD STORAGE BATTERY IN NEW HANDS.—We are informed that the Willard Electric & Battery Company, Cleveland, Ohio, has been absorbed by Messrs. Sipe & Sigler, a well-known manufacturing firm in that city. It is the intention of the new proprietors to give their entire time and attention to the manufacture and sale of the Willard battery. Mr. Theodore A. Willard, the inventor of the battery, and Mr. H. M. Hawley have become members of the firm of Sipe & Sigler, and the business will henceforth be conducted under this firm name. It is stated that the old firm was obliged to refuse many large orders every month, owing to its inadequate factory capacity and its lack of capital, and it was to secure both of these and future business, too, that the deal just consummated was negotiated. There is every reason to believe that the new combination will be an effective one, and that the Willard battery will be heard of more. The batteries will be manufactured in the Sipe & Sigler power building, which is said to be an excellently appointed one. It has six stories and a basement, and covers an area of 35

feet by 165 feet. The entire building will be occupied in the work of manufacturing Willard batteries of all types and sizes, each one adapted for its own particular use. The different floors of the building are being equipped with the finest special machinery, and preparations are being made to operate the entire factory continuously the full twenty-four hours in order to manufacture storage batteries on a large scale to meet the demand. Both Messrs. Sipe & Sigler have worked their way to the front ranks of Cleveland's business men, and are said to enjoy a reputation for business acumen and enterprise.

MESSRS. CHARLES A. SCHIEREN & CO., New York City, report among recent sales of wide main driving belts the following: Troy Gas Light Company, Troy, N. Y., one 72-inch three-ply belt; Consolidated Electric Light & Power Company, Kansas City, Kan., one 60-inch three-ply belt; Southern Electric Light & Power Company, Philadelphia, Pa., two 64-inch three-ply leather belts; the Jackson Company, Nashua, N. H., two 48-inch three-ply belts, and one 46-inch three-ply belt; Economy Light & Power Company, Joliet, Ill., two 44-inch double belts and two 24-inch leather belts; Hudson Electric Light Company, Hoboken, N. J., one 37-inch three-ply leather belt; Manhattan Electric Light Company, New York City, one 36-inch double, and one 31-inch three-ply leather belt; Manchester Electric Light Company, Manchester, N. H., two 36-inch double belts; West Jersey & Seashore Railroad Company, Atlantic City, N. J., one 37-inch, 1 inch thick link belt; Quincy & Boston Street Railway Company, Quincy, Mass., one 36-inch three-ply belt; Warren Electric Light Company, Warren, Pa., one 30-inch double belt; Minneapolis General Electric Company, Minneapolis, Minn., two 36-inch three-ply belts; Van Choate Electric Company, Boston, Mass., one 33-inch double, two 30-inch doubles and one 24-inch double belt; Southern Electric Light & Power Company, Philadelphia, Pa., one 32-inch double belt; Apple River Power Company, New Richmond, Wis., one 32-inch double leather belt; Consolidated Electric Light & Power Company, Kansas City, Kan., one 32-inch three-ply leather belt; Detroit & Pontiac Railway Company, Detroit, Mich., one 31-inch three-ply leather belt; Newton & Boston Street Railway Company, Newtonville, Mass., one 30-inch double leather belt; John A. Roebling's Sons Company, Trenton, N. J., one 30-inch double leather belt; Charleston Thomson-Houston Electric Company, Charleston, Ill., one 26-inch double leather belt; Edison Electric Illuminating Company, York, Pa., one 26-inch double belt; North River Electric Light Company, New York City, one 24-inch double leather belt; Newburyport & Amesbury Street Railroad Company, Newburyport, Mass., one 24-inch double leather belt.

Business Notice.

PICTURES TELL THE STORY of how everything looks in South Dakota as the result of the great crops of the last three years. The Chicago, Milwaukee & St. Paul Railway Company has had photographs taken of actual farm scenes in South Dakota, and has had them reproduced in an attractive eight-page illustrated circular, which it is distributing free of cost to all who are looking for new homes in the most fertile section of the Middle Northwest. Send your address to H. F. Hunter, Immigration Agent for South Dakota, 291 Dearborn Street, Chicago, Ill., or to W. E. Powell, General Immigration Agent, 410 Old Colony Building, Chicago, Ill.

Illustrated Record of Electrical Patents.

595,293. ELECTRIC RAILWAY; J. R. Farmer, St. Louis, Mo. App. filed March 2, 1896. In an electric railway, employing surface contacts and a bridging shoe carried by the car, having means for rendering it magnetic to operate a circuit closer in the roadbed; a contact device having a magnetic contact exposed on the surface, and having a projecting horn also of of magnetic material, and extending in the direction from which the car approaches, whereby a preliminary effect is produced on the circuit closer.

595,294. RAILWAY SIGNAL; W. J. Fawcett, Pittsburg, Pa. App. filed Feb. 4, 1897. In an electric signalling device for street cars, the combination with the bracket mounted on the car, a solenoid magnet supported thereon, of a vertically movable spiral armature bar, designed to work within said magnet, a slotted bracket arm through which the spiral portion of the armature bar reciprocates to cause a rotary movement thereto, a signal board mounted on the bar, and a spring to return the latter to its normal position.

595,325. ELECTRIC METER; W. D. Marks, Philadelphia, Pa. App. filed Sept. 10, 1897. In an electric meter, the combination with an oscillating electric motor or pendulum and an oscillator actuated thereby for driving a register, of a circuit controller for periodically opening and closing the motor circuit, comprising a contact plate carried by the oscillator, a second contact pivoted to a stationary support eccentrically to the oscillator, and capable of movement independently of the oscillator, and an insulating guard on said oscillator for limiting the movement of said pivoted contact.

595,327. ELECTRICAL LIGHTER FOR BURNERS; S. M. Meyer, Brooklyn, N. Y. App. filed Nov. 6, 1896. The combination of a case, batteries and conductors, with a metallic lamp cone and a resistance coil in the circuit, which is closed by the application of the lighter to the lamp burner.

595,329. MEANS FOR GENERATING ELECTRICITY FROM CAR WHEEL AXLES; M. Moskowitz, Newark, N. J. App. filed May 17, 1897. The combination with a working or main circuit containing lamps or other electrical translating devices, of a dynamo in said circuit, wound with a main exciting shunt coil around the field thereof, a series coil wound in the opposite direction around the field of said dynamo, a high resistance shunt coil fed from the dynamo, and an automatic regulating device comprising a series coil and a make-and-break device connected therewith for regulating the flow of electricity.

595,330. ELECTRIC REGULATOR; M. Moskowitz, Newark, N. J. App. filed May 26, 1897. An electric regulator, comprising, in combination, a coil, a movable plunger in said coil, a frame connected with the ends of said plunger, a pair of contact arms connected with said frame and contact posts between which said arms are adapted to vibrate.

595,338. INSULATED JOINT FOR GAS FIXTURES; J. W. Parkin, Philadelphia, Pa. App. filed Jan. 11, 1897. In a joint for gas fixtures, a plurality of members, peripheral flanges on adjacent ends of said members, an insulating plate between said ends and flanges, insulating rings on the outer sides of said flanges and sectional sleeves, one of which is adapted to fit within the other, whereby the same are held in position.

595,343. BLIND RAISED OR LOWERED BY MEANS OF ELECTRICITY AND SOLAR RAYS; E. Roth, Osnabruck, Germany. App. filed Dec. 5, 1896. In combination with a shade roller or the like, a motor for operating the same, a sunshine operated circuit closer, comprising a U-shaped tube containing a circuit closing fluid, three switch plates, circuit wires extending from said switch plate to the circuit closer, and adapted to form two circuits, the switch having electrical connection with the motor and having two arms adapted to contact with two of the switch plates, and means for automatically shifting said switch at the limit of the movement of the shade roller in either direction to reverse the polarity of the armature and field, with relation to each other.

595,344. CONTROLLING DEVICE FOR ELECTRIC MOTORS; F. J. Russell, New York, N. Y. App. filed April 22, 1897. The method of controlling an electric motor, which consists in establishing in an electromagnetic circuit closing device a succession of current impulses corresponding in direction to the deviation of the controlling lever, and thereby causing the armature of said motor controlled by said device to move in a direction corresponding to the direction of said current impulses and to an extent depending upon the number of current impulses.

595,345. ELECTRICAL CONTROLLING MECHANISM; F. J. Russell, New York, N. Y. App. filed May 7, 1897. The combination in an electric controlling device of two fixed contact plates, a movable contact plate, the faces of said plate being inclined and substantially parallel, and a body of insulating material on one face of the plate.

595,364. SPACE BLOCK FOR ARMATURE CORES; A. F. Barchelder, Schenectady, N. Y. App, filed Sept. 15, 1897. A space block for armature cores, consisting of an internal support or spider, a circumferential ring mounted on the arms of the spider, and radial arms, consisting of thin strips of metal mounted on said circumferential ring.

595,367. JOINT FOR ELECTRIC CABLES; W. M. Brown, Johnstown, Pa. App. filed Aug. 10, 1897. A "T" for electric cables comprising in combination a central member surrounding and secured about naked portions of the cables, insulating material surrounding the said central member, and naked portions and a metal covering surrounding said insulators.

595,375. ELECTRIC SIGNALLING APPARATUS; W. E. Decrow, Boston, Mass. App. filed July 17, 1897. In an electric signalling apparatus, a signal box having means for transmitting two classes of signals, one of which is accompanied by a differential impulse, a message recording instrument for receiving the signals of both classes, and a bell constructed and arranged to respond successively to the impulses of one class of signals, and to respond continuously upon the reception of a signal of the other class.

595,395. RHEOSTAT OR ELECTRIC HEATER; F. Kraemer, Chicago, Ill. App. filed Jan. 23, 1896. In an electric rheostat or heater, solid sticks of a high resistance completely embedded in a plastic material composed of barite or its equivalent and silicic acid.

595,398. ELECTRIC ALARM DEVICE; F. Louis, Brooklyn, N. Y. App. filed Jan. 7, 1897. A signal apparatus for steam boilers, said apparatus consisting of a steam pipe which is connected with said boiler, and provided with a downwardly directed loop or bend, in which is placed quicksilver or similar material, a vertically movable float suspended in the upwardly directed arm of said loop or bend by means of a cord or similar device, which passes over pulleys, and to the end of which is secured a weight, which moves in a vertical guide or casing, an electric alarm device, a battery in connection therewith, and devices which are adapted to be operated by said weight for closing an open circuit, in which said battery and said alarm device are placed.

595,402. CONDUCTOR FOR ELECTRICAL APPARATUS; J. Millis, of United States Army. App. filed March 27, 1897. An electric conductor made of thin strips or laminations of material which is both conductor of electricity and also capable of being effected by and of readily transmitting magnetic force or influence, and having the laminæ separated by insulating material.

595,403. TRANSFORMER; W. S. Moody, Lynn, Mass. App. filed Feb. 10, 1897. In a transformer, the combination of a core, a winding mounted thereon, and a winding in inductive relation to the first-named winding and connected to a three-wire circuit, comprising a plurality of coils connected to each side of the three-wire circuit, said coils being co-arranged on the core that they receive substantially equal induction from the first-mentioned winding under balanced and unbalanced loads.

595,410. ELECTRIC MOTOR; E. D. Priest, Schenectady, N. Y. App. filed April 13, 1897. In an electric railway motor, the combination of a field magnet frame, a bearing for maintaining the field magnet in alignment with the car axle, a separate frame head at one end of the motor, said field

magnet and head forming an inclosed structure protecting the armature and commutator, and armature bearings extending under the projecting parts of the armature.

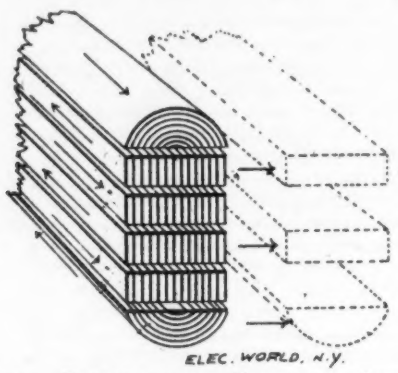
595,412. REGULATING ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE; E. W. Rice, Jr., Schenectady, N. Y. App filed Oct. 26, 1894. The combination of an alternating current generator, an exciter having an armature and field magnet independent of the corresponding elements of the generator, means for driving said exciter, and means for superposing upon the current in the armature of the exciter a current of a magnitude and phase varying in accordance with the magnitude and phase of the current from the main generator, and thereby regulating the said main generator both for inductive drop and resistance drop.

595,413. BRAKING ALTERNATING CURRENT INDUCTION MOTORS; E. W. Rice, Jr., Schenectady, N. Y. App. filed March 6, 1897. The method of braking the load connected to an induction motor, which consists in connecting the motor with a circuit capable of absorbing energy, and passing through its inductive member an alternating magnetizing current, of a frequency such that the motor will act as an induction generator.

595,419. METHOD OF AND APPARATUS FOR CONVERTING ELECTRIC CURRENTS; E. Thomson, Swampscott, Mass. App. filed Feb. 27, 1897. The art of converting electric energy, which consists in energizing a coil at relatively high potential, breaking the circuit of the coil, and at about the same time closing the circuit of a low potential coil in inductive relation thereto, and then interrupting the current flow in the second coil, thereby setting up in another coil the desired E. M. Fs.

595,420. ELECTRIC ARC LAMP; E. Thomson, Swampscott, Mass., and C. E. Hartman, Lynn, Mass. App. filed June 12, 1897. In an electric arc lamp, a central carbon carrying device, a yoke secured thereto, dash pots suspended from said yoke parallel with the carbon carrying device, and pistons engaging said dash pots.

595,444. ILLUMINATING DEVICE FOR KEYHOLES; F. W. Roll and F. Waltman, Denver, Col. App. filed May 20, 1897. In a device for illuminating keyholes, the combination with the lock casing, of a lamp supported therein, a push button projecting through the lock casing and door to make and break the current; together with an angle piece connected to one of the wires from the lamp, and extending through the lock casing, from which it



No. 595,402.—Conductor for Electrical Apparatus.

is insulated, the other wire for the lamp being connected to the lock casing, a spring actuated pin located within the door jamb to engage the outer end of the angle piece, and a block located within the keeper to contact with the shooting bolt, the block and pin being connected by wire to the source by which the electric current is generated.

595,472. MECHANISM FOR LINING METAL TUBES WITH PLIABLE MATERIAL; E. T. Greenfield, New York, N. Y. App. filed April 29, 1897. Mechanism for lining tubes with pliable or fibrous material, consisting of means for forming a tube from strips thereof, means for inserting said tube within the tube to be lined and then inflating it, a carriage for carrying said tube and a controlling valve for regulating the operation of said parts, in combination with valve controlling means carried by the carriage.

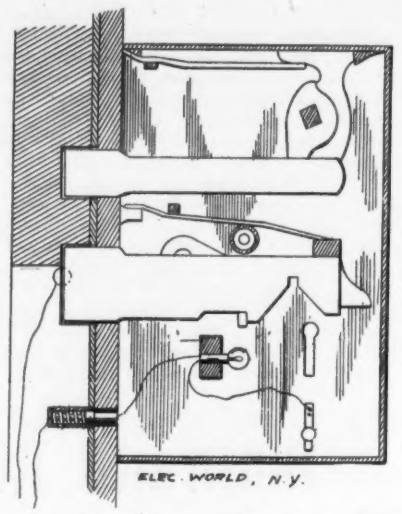
595,543. TUBULAR TRIPOD FOR LIGHTNING RODS; G. R. Kress, Pittsburg, Pa. App. filed Aug. 21, 1897. A brace for lightning rods comprising an upright tube incasing the end of the conductor cable and legs at its lower end, whereby it is secured to the building.

595,570. CONTROLLING DEVICE FOR ELECTRIC RAILWAYS; R. M. Hunter, Philadelphia, Pa. App. filed Oct. 11, 1897. The combination of one or more electric motors, electric circuits leading from a source of electric energy, and connecting with said motors for supplying current thereto, and a regulator in series with the motor or motors, consisting of a counter-E. M. F. generator, comprising an armature revolving in fixed relation to field magnets, one or more resistances, and a hand switch for varying the counter E. M. F. of the generator at intervals, and then during the intervals inserting and removing from the circuit the said resistances while retaining the counter E. M. F.

595,573. GALVANO CAUTERY INSTRUMENT; C. MacGregor, Dayton, Ohio. App. filed Oct. 16, 1897. A galvano cautery instrument, comprising a two-part handle, each of said part provided with longitudinal grooves and cavities therein, a continuous and disconnected electrode inclosed in said longitudinal grooves, contact blocks loosely seated in said cavities, and having screw threaded engagement with the inner ends of the disconnected electrode, and walls of insulating material between said blocks and the continuous electrode.

595,575. ELECTRIC SIGNAL INDICATOR; M. Mercier, Manchester, England. App. filed March 3, 1897. The combination of an indicating member, an electromagnet having an armature adapted to actuate said member, means controlled by a dash pot for automatically returning said indicating member to its initial position after a predetermined period of time, and a secondary electromagnet adapated to operate upon said dash pot to cause an immediate return of the indicating member.

595,580. SECONDARY BATTERY; P. F. Ribbe, Berlin, Germany. App. filed April 7, 1896. In an electrode for secondary batteries, the combination with a wooden frame, of two celluloid plates connected with each other by dissolved celluloid, said plates having openings with upturned edges, active material in said openings and a lead plate between the celluloid plates.

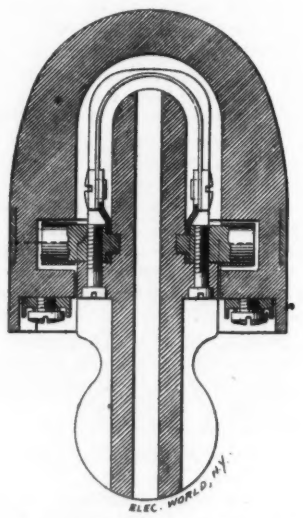


No. 595,444.—Illuminating Device for Keyholes.

595,584. INCANDESCENT LAMP SOCKET; D. A. Schutt, Peru, Ind. App. filed April 16, 1897. A three-part socket composed of insulating material, comprising a base provided with a securing bush, a lamp socket, a rigid metallic intervening connecting post, and an intervening movable knurled edge shifting ring provided with wire connections, and contact springs arranged to make electrical connection with terminals in the lamp socket.

595,585. FUSE BLOCK; D. A. Schutt, Peru, Ind. App. filed April 16, 1897. A fuse block comprising a circular, dome-shaped, hollow body of insulating material, internal annular pin retaining flanges integral therewith on the opposite inside faces thereto, with intervening openings, an annular space above the flanges, with oppositely located contact springs therein provided with connections for feed wires, and an insertible plug of insulating material provided with oppositely located contact pins and a connecting fuse.

595,590. ELECTRIC RAILWAY SYSTEM; M. J. Wightman, Scranton, Pa. App. filed Aug. 10, 1896. In an electric railway employing disconnected sections of working conductor and a continuous flexible current conveyor adapted by magnetic attraction to close the circuit between said sections and a source of supply, a plurality of downward projections on each of said



No. 595,585.—Fuse Block.

conductor sections against which the flexible conveyer contacts when magnetically actuated.

595,619. COMBINATION ATTACHMENT PLUG; J. F. Gates, Pittsburg, Pa. App. filed Feb. 19, 1897. A combination plug for electric lamp sockets, consisting of a plug proper having a detachable reversible contact pin, provided with heads of differential sizes.

595,659. TROLLEY STAND; S. S. Short, Cleveland, Ohio. App. filed Sept. 26, 1896. In a trolley stand, the combination of a base, a trolley-arm support pivoted thereto on a vertical axis, and a spring carrying rod secured to said support, with a trolley arm pivoted upon a horizontal pivot to said support, a collar movable upon said rod, links connecting said collar and downward extensions of the trolley arm, and a spring which embraces said rod, and lies between the collar and a flange or nut on the end of the rod.

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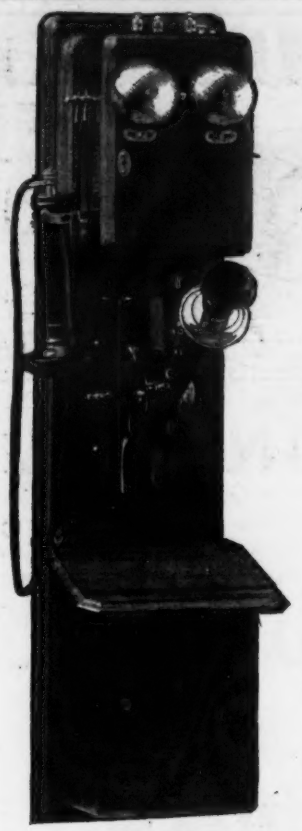

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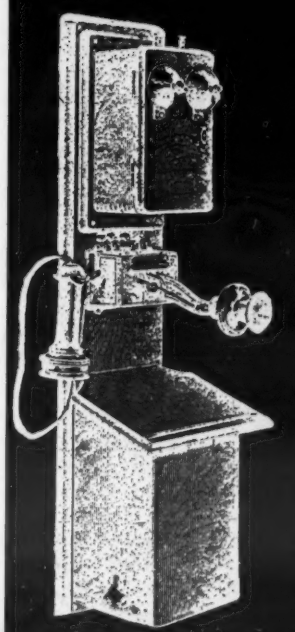

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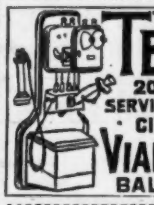

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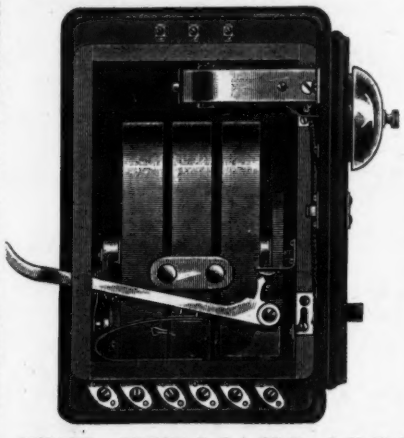

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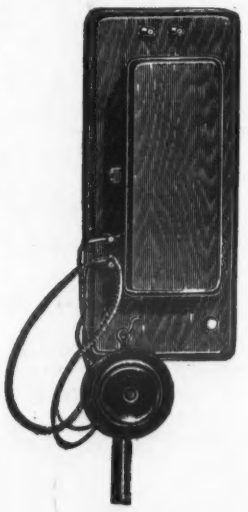

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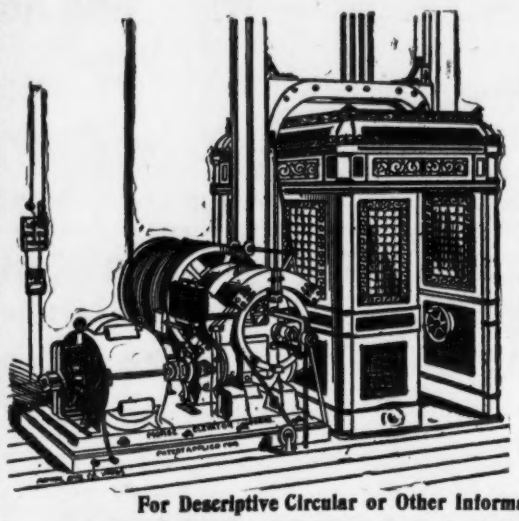

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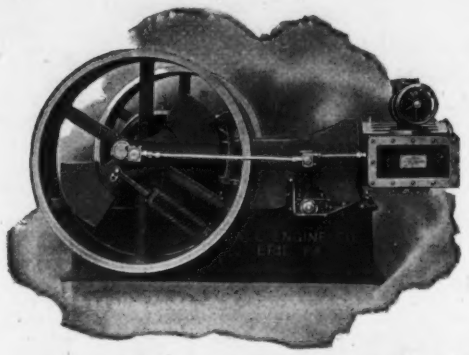

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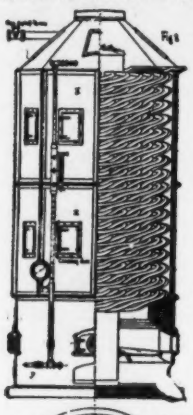

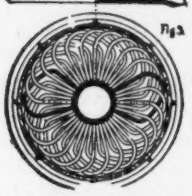

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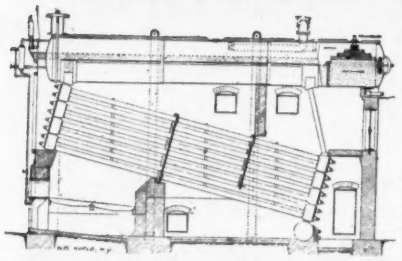

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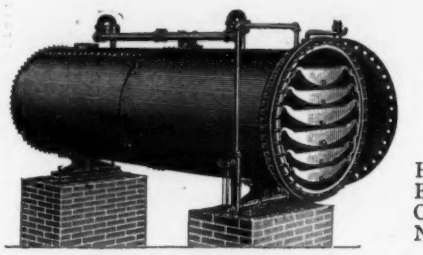

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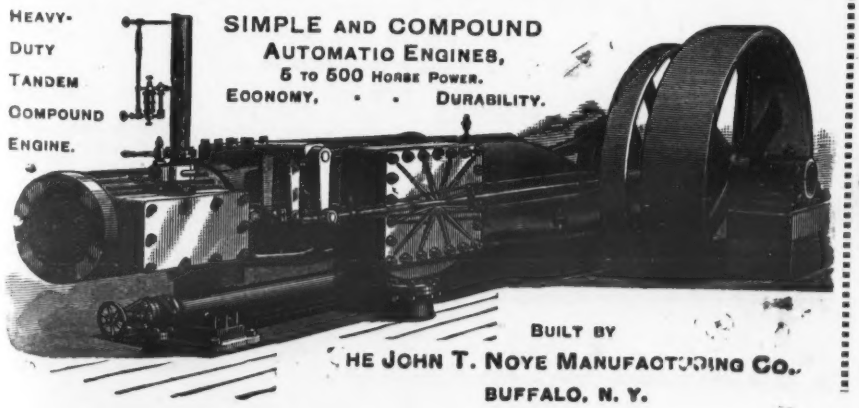

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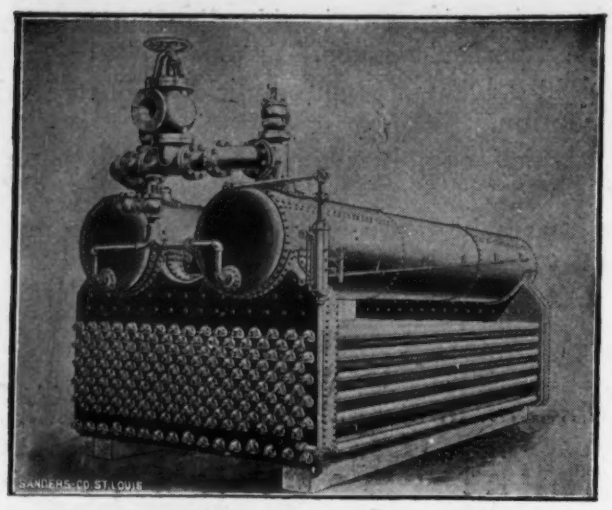

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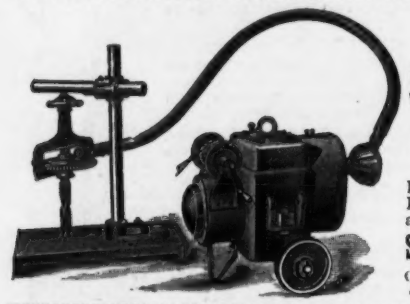

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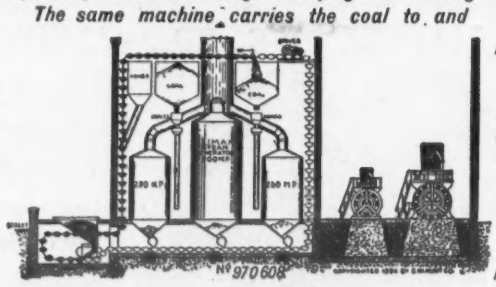

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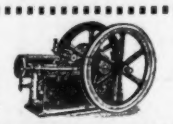

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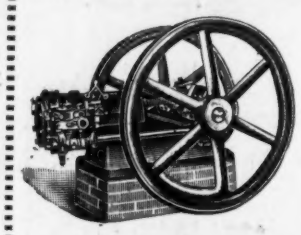

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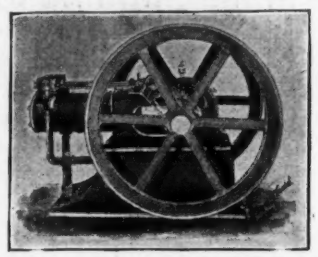

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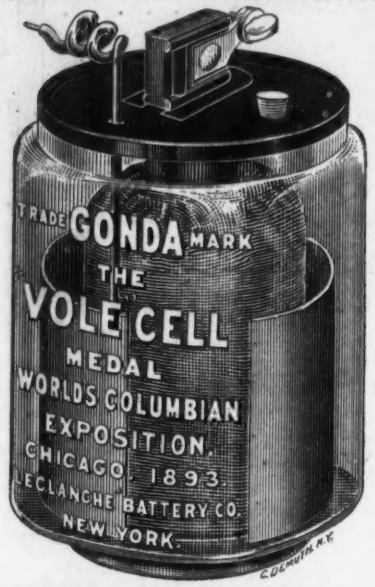

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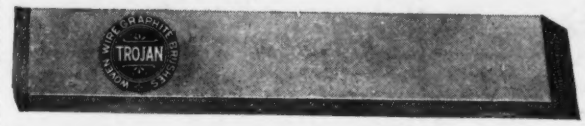

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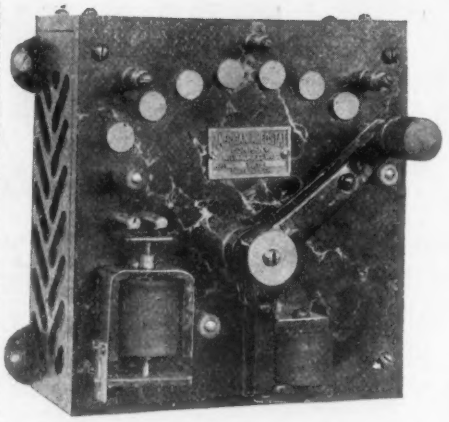

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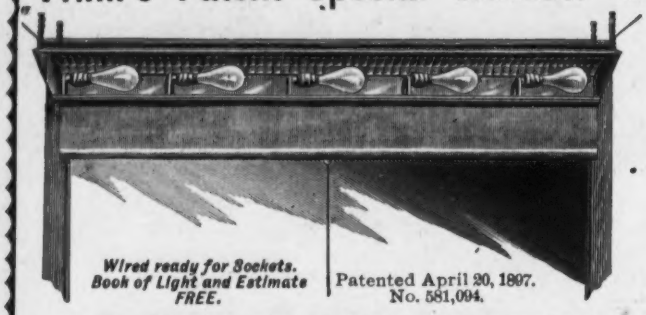

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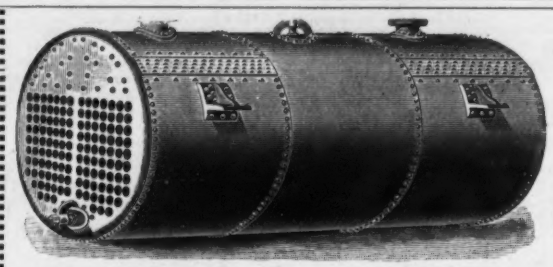

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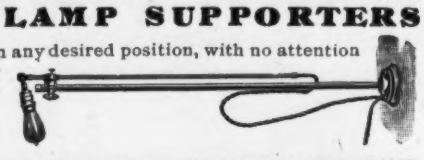

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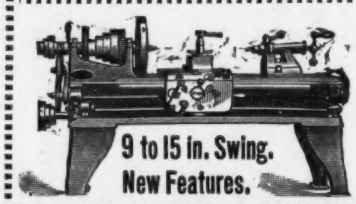

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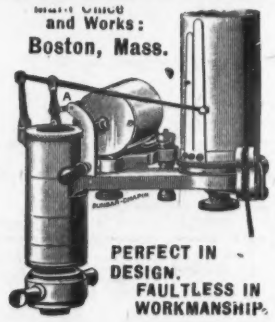

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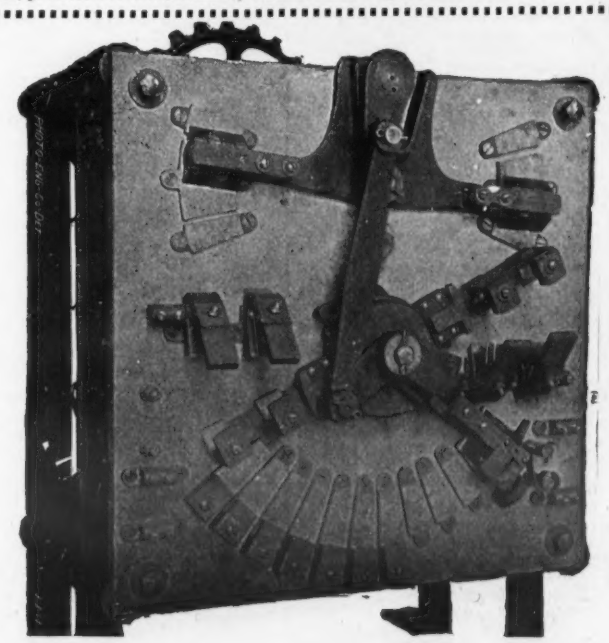

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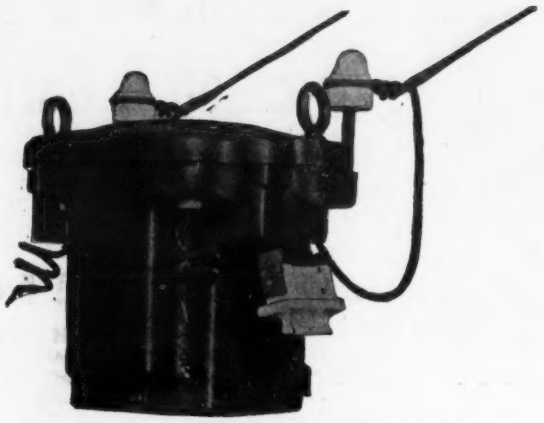

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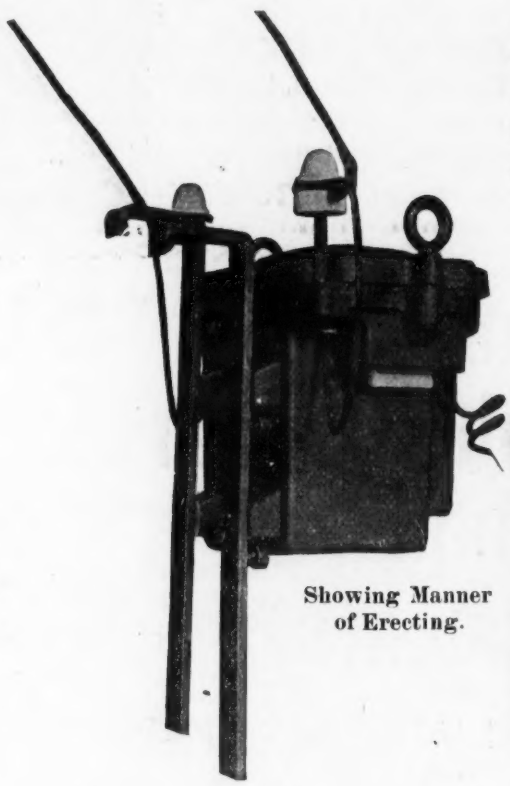

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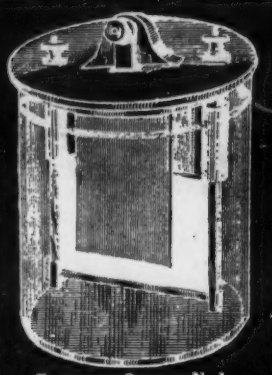

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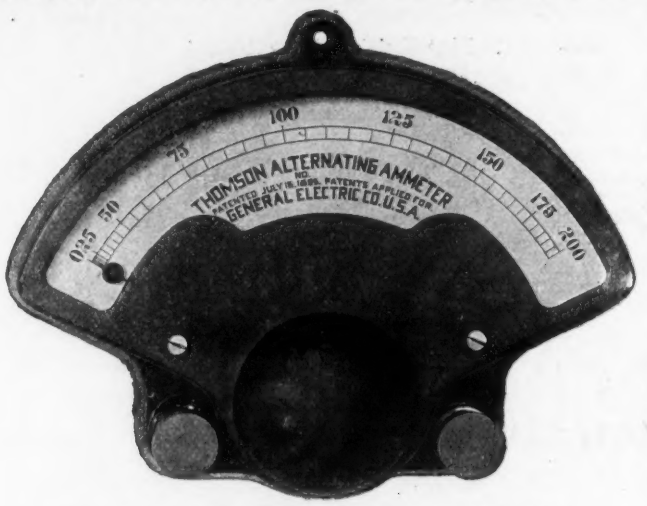
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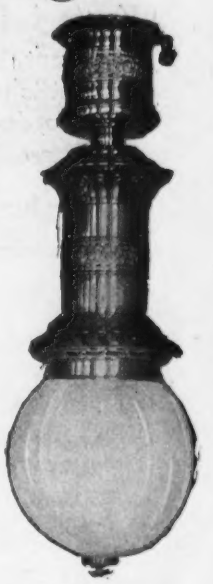

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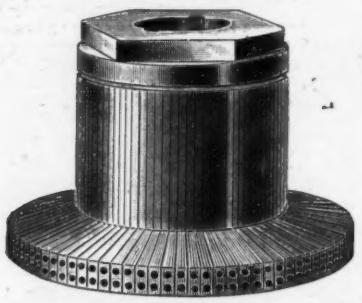

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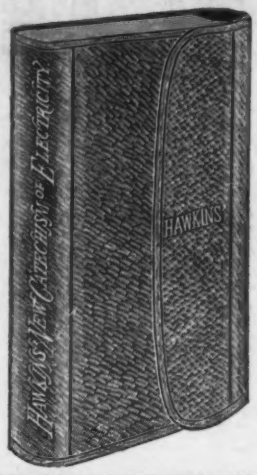

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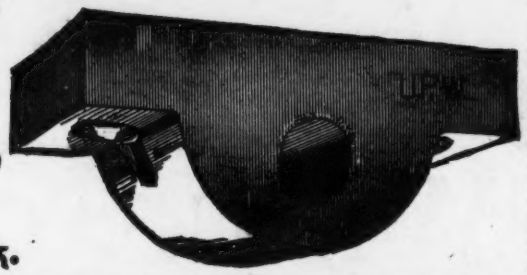

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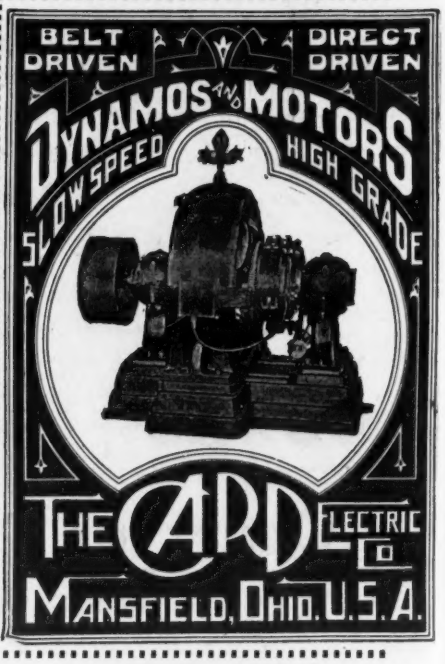

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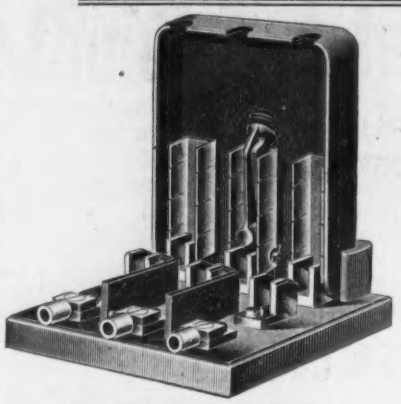

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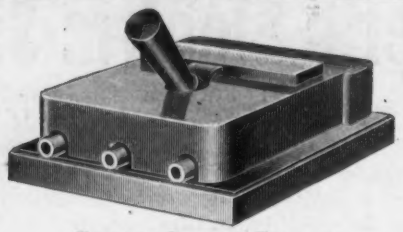

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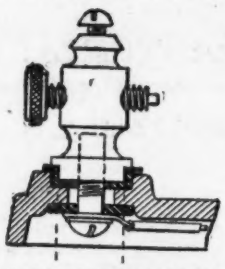

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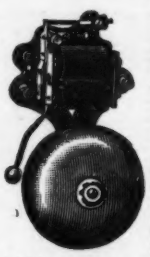

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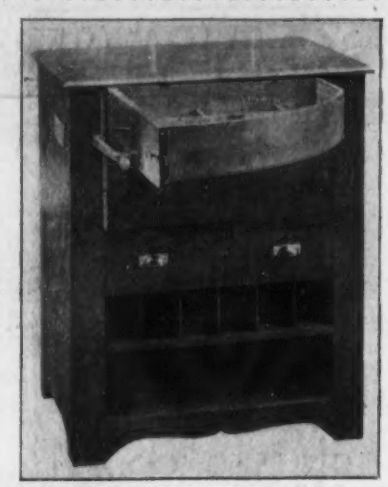

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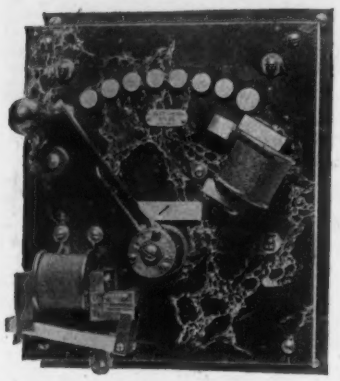

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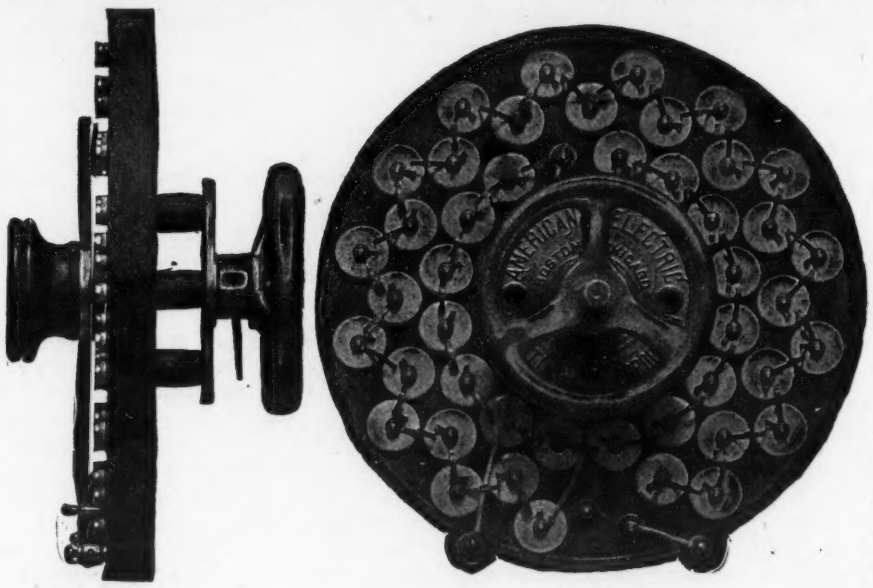

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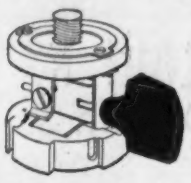

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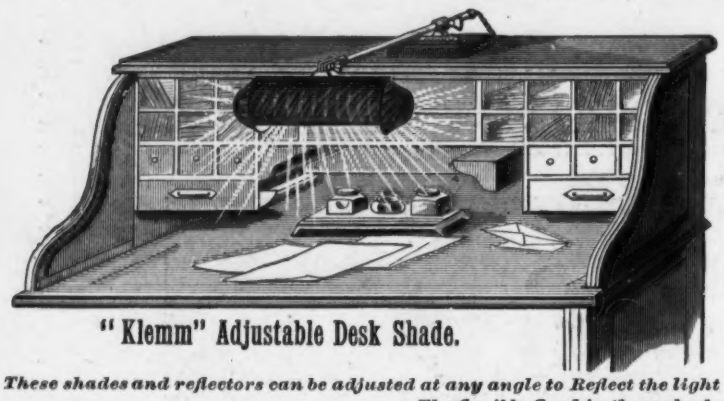

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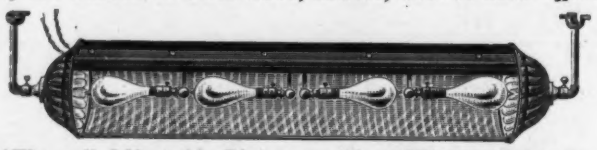

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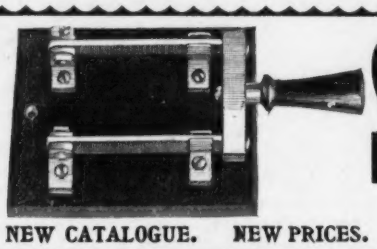

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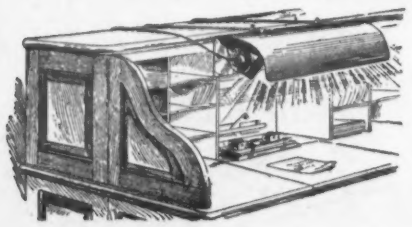

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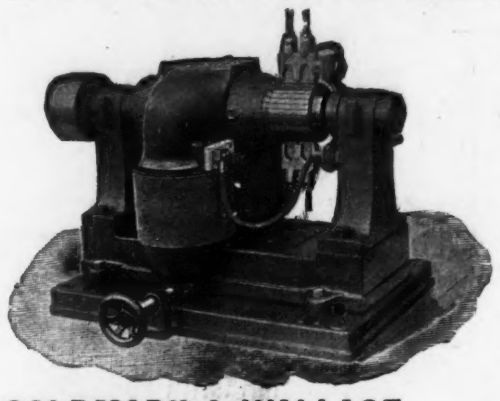

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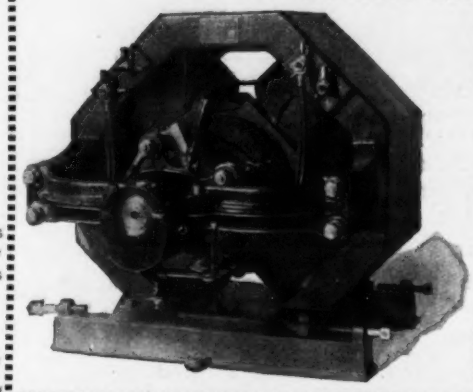

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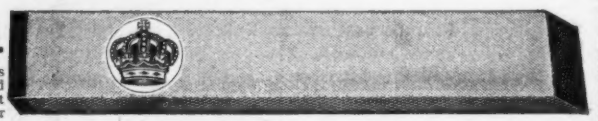

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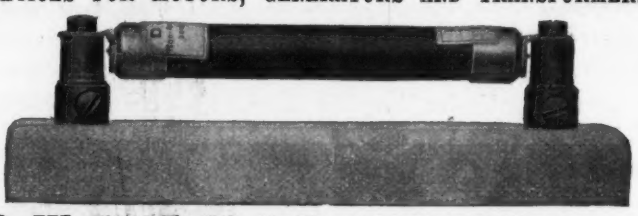

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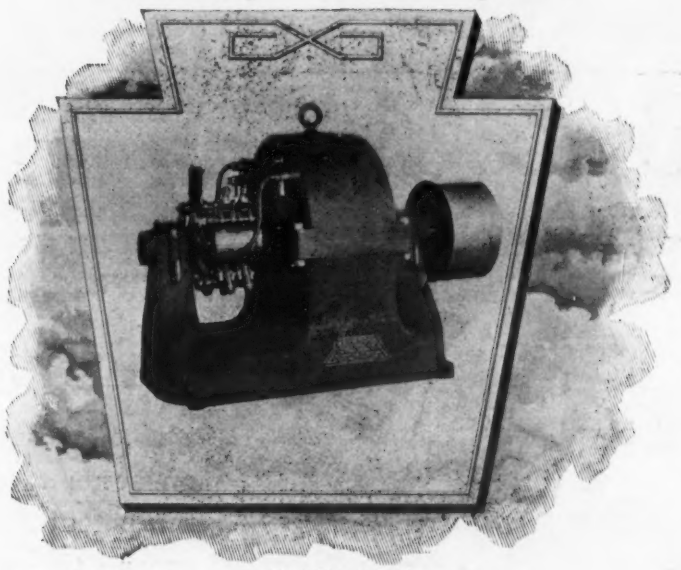

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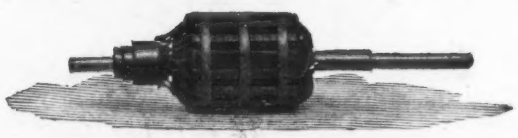

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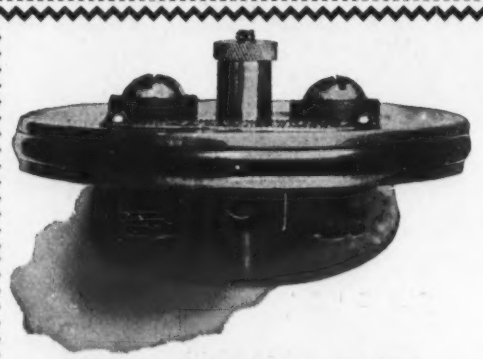

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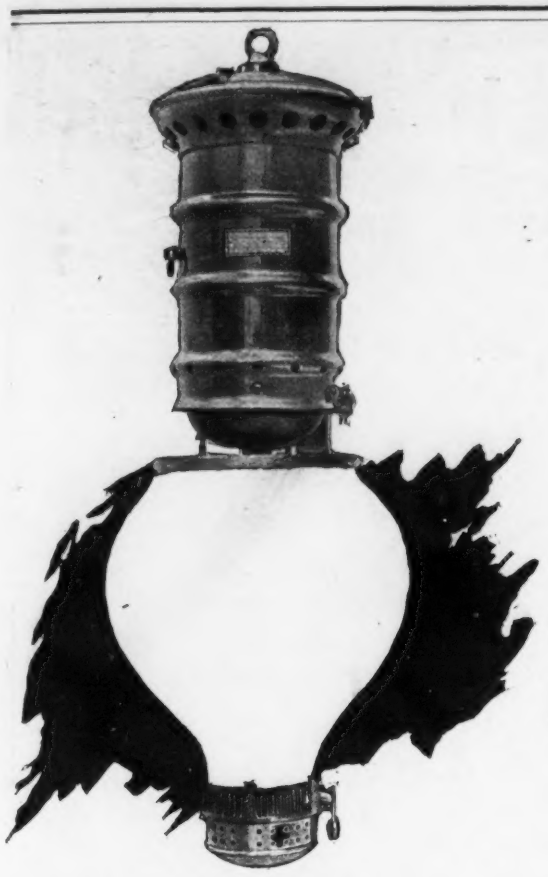

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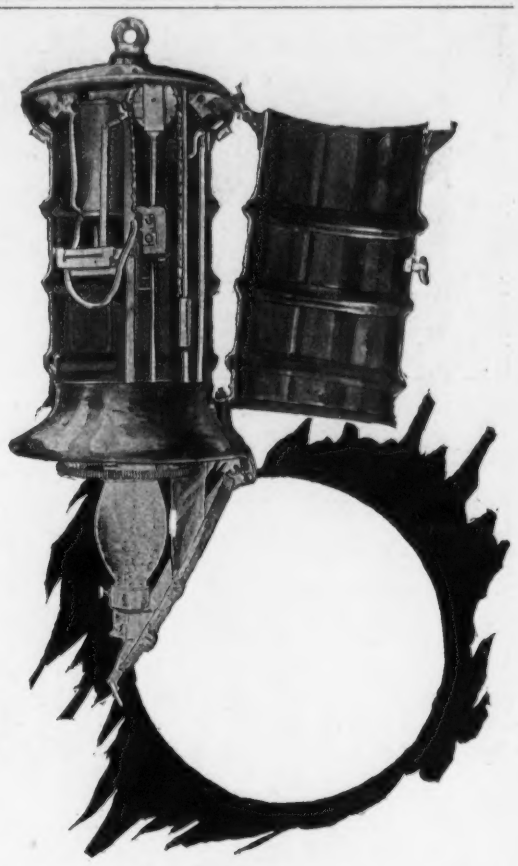

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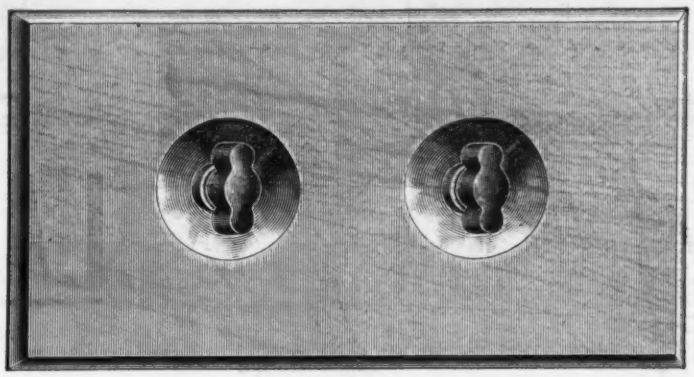

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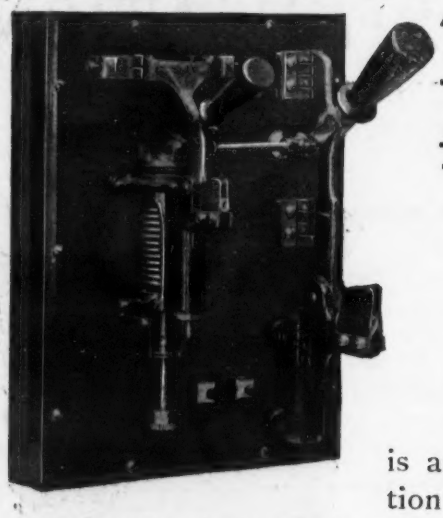

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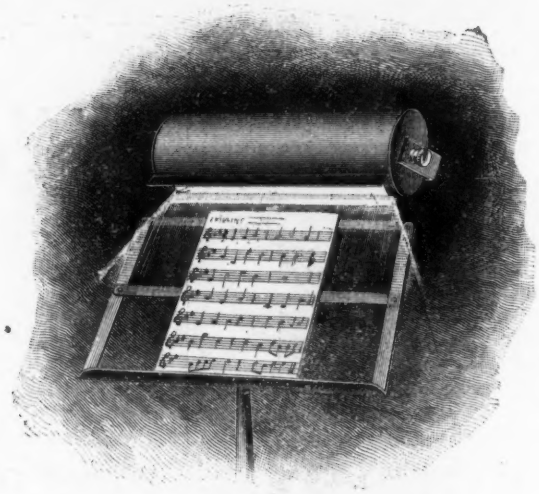

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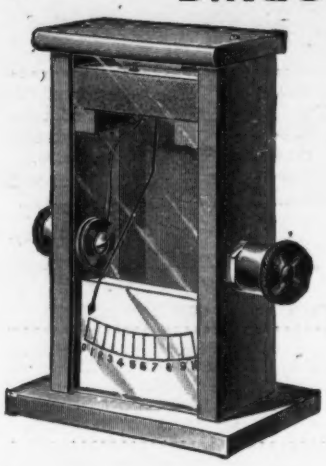

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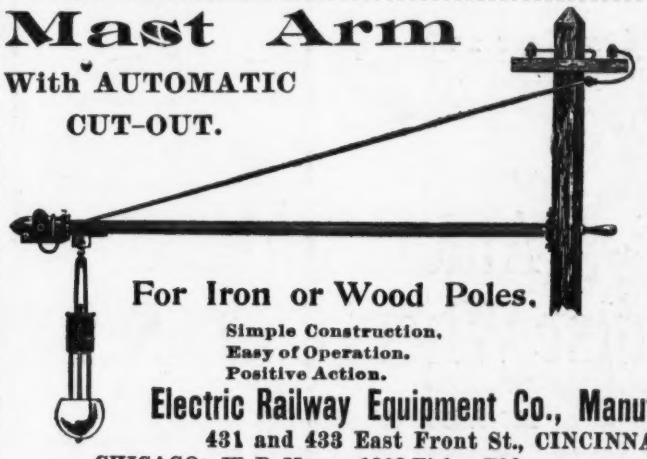

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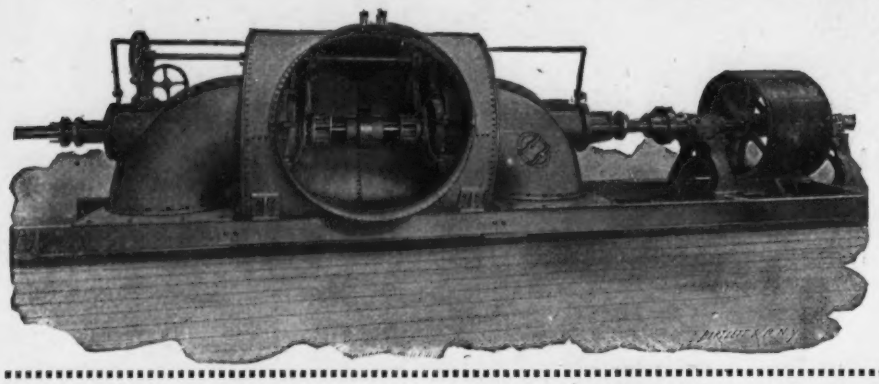

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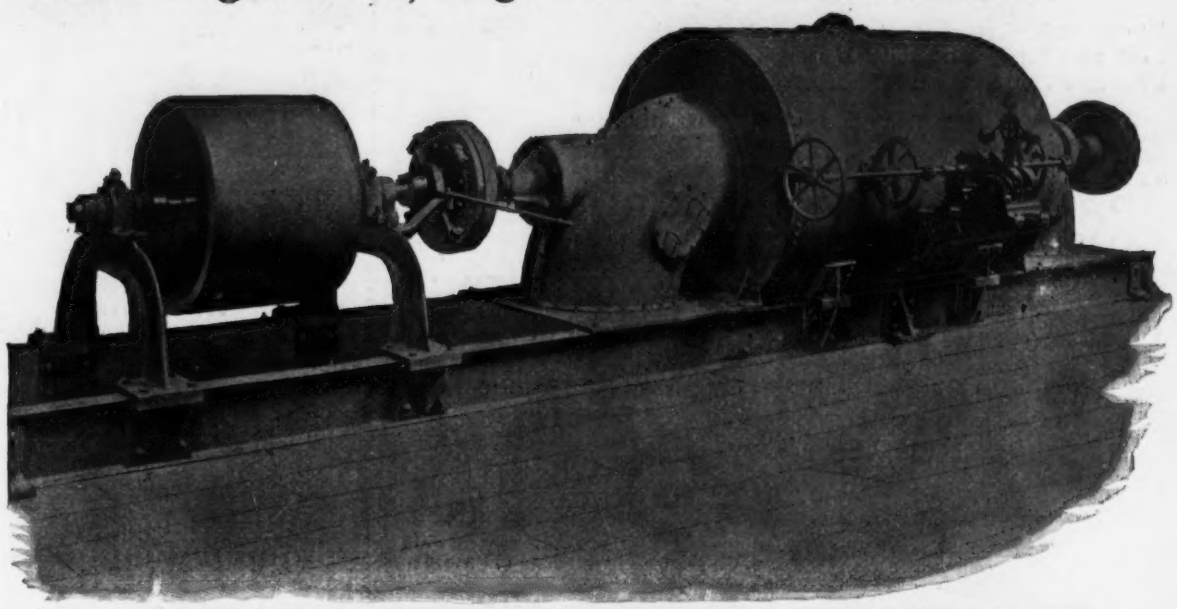

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Full	15.00	144.00	172.69	240.97	82.03	Full	15.29	194.25	102.02	143.44	81.08
7/8	15.04	138.12	155.03	223.61	84.55	7/8	16.56	187.75	92.15	146.73	84.78
3/4	15.11	127.67	133.24	191.06	83.68	3/4	17.33	178.50	83.95	138.40	83.88
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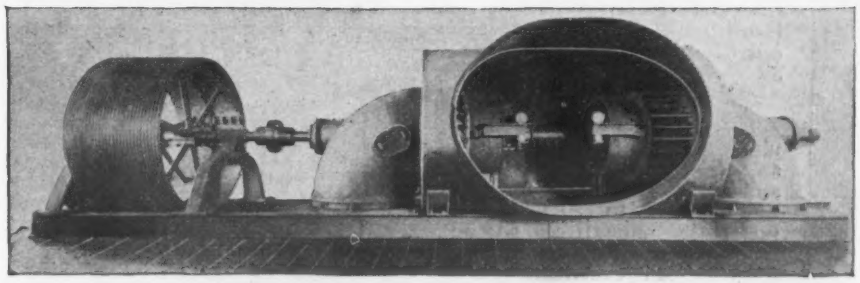

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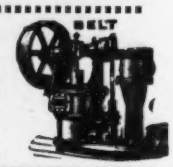

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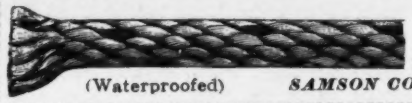
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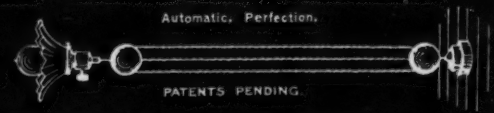

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All Guaranteed.

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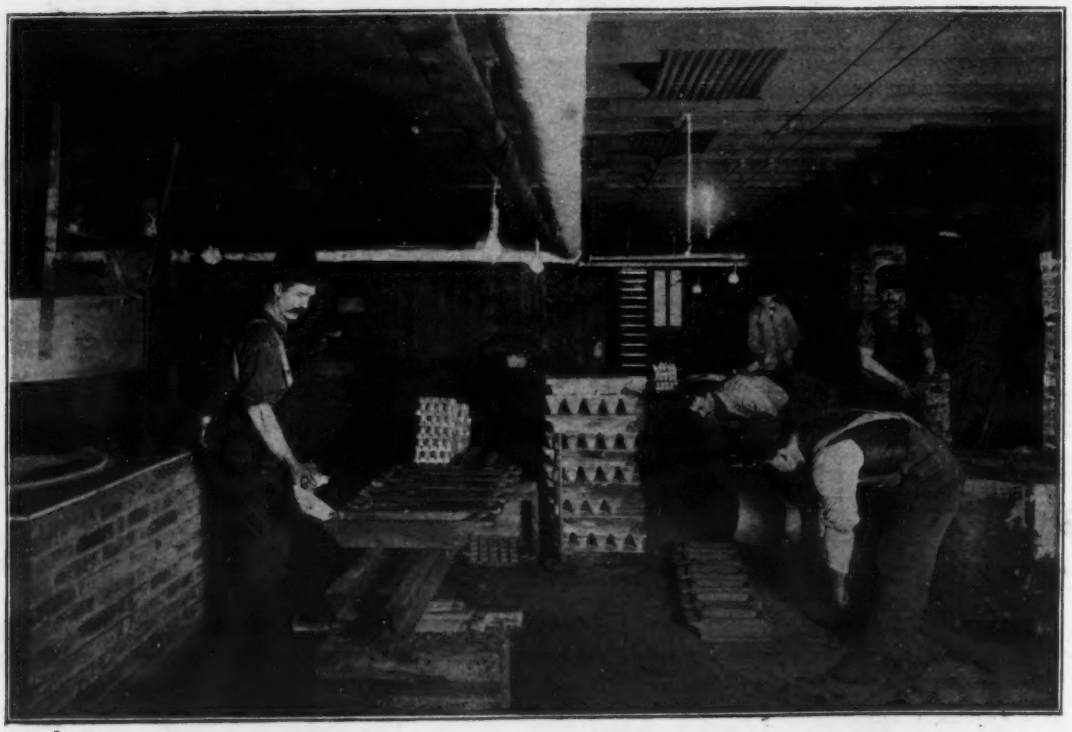

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THE ELECTRICAL WORLD

AN ILLUSTRATED WEEKLY REVIEW OF CURRENT PROGRESS IN ELECTRICITY AND ITS PRACTICAL APPLICATIONS

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Vol. XXX. No. 26. NEW YORK, DECEMBER 25, 1897. $3 a Year in the U. S., Canada or Mexico. $6 to Foreign Countries in the Postal Union.

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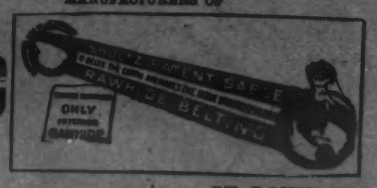

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STEEL SPLIT BOXES FOR ⅝ CONDUIT.

Note the good points of this box!
Note the length of the projecting lugs!
Note from this that the conduit cannot run too far into box!
Note that it is non-breakable!
Note that the inner rim of outlet is smaller than the outer!
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WE ARE SELLING OUT THE STOCK OF THE

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Which consists of Rubber Covered Wire, Weatherproof Wire, Magnet Wire, Porcelain and Clay Wiring Tubes, Incandescent Lamps, Carbons, Tools of all kinds, House Annunciators, Push Buttons, and a general assortment of Electric Supplies of standard manufacture.....

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Direct Connected Units of all Sizes.

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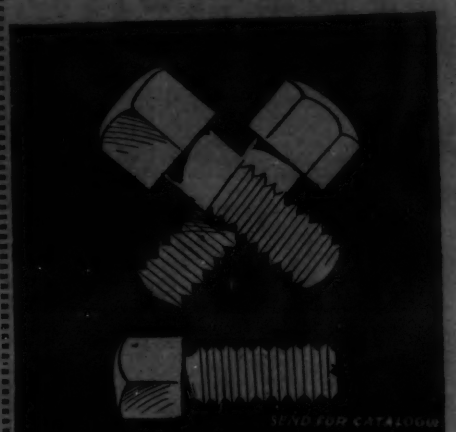

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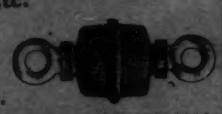

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